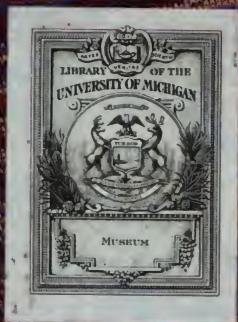
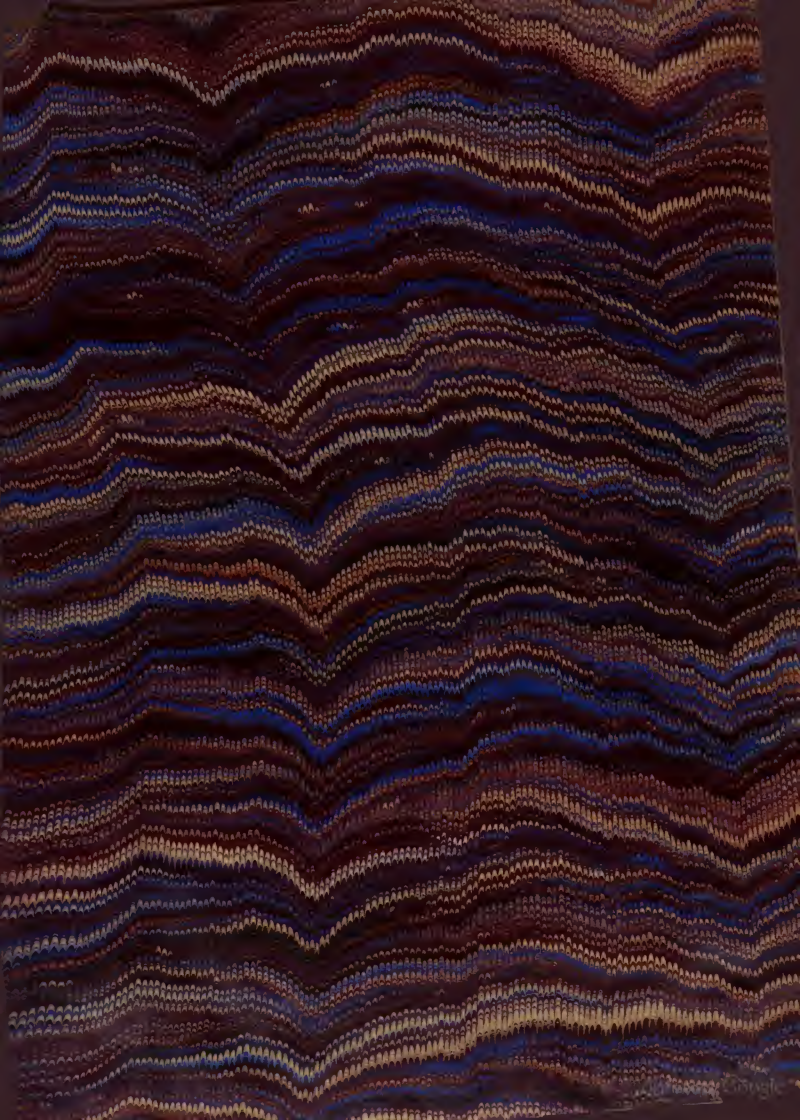


FOSSIL FLORA OF THE GONDWANA SYSTEM ...

Thomas Oldham, John Morris,
Ottokar Feistmantel







Voc 711 ~ 2 vol ~ 30/-

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MEMOIRS
OF THE
GEOLOGICAL SURVEY OF INDIA.

India. Geological Survey.
Paleontologia Indica,

BRING

FIGURES AND DESCRIPTIONS OF THE ORGANIC REMAINS PROCURED DURING
THE PROGRESS OF THE GEOLOGICAL SURVEY OF INDIA.

PUBLISHED BY ORDER OF HIS EXCELLENCY THE GOVERNOR GENERAL OF INDIA IN COUNCIL.

Ser. XII. THE FOSSIL FLORA OF THE LOWER
GONDWANAS.

Vol. 1. **I.—THE FLORA OF THE TALCHIR-KARHARBARI BEDS,**
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CALCUTTA:

SOLD AT THE
OFFICE OF SUPERINTENDENT OF GOVERNMENT PRINTING;
GEOLOGICAL SURVEY OFFICE; AND BY ALL BOOKSELLERS;
LONDON: TRÜBNER & CO.

MDCCLXXIX.

PRINTED AT THE OFFICE OF SUPERINTENDENT OF GOVERNMENT PRINTING, BASTING ROAD, CALCUTTA.

1879

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PREFACE.

THE present fasciculus is the first containing illustrations and descriptions of fossil plants from the lower portion of the great Gondwána system of India; and according to the natural sequence, this fasciculus illustrates the fossil plants of the lowest group of strata in that portion, *i. e.*, of the Talchir-Karharbári beds, of the new classification.

The fossil plants of the Damuda division will be illustrated in a subsequent fasciculus, which will also include the plants of the Panchet division, these being only very few.

The present number contains 22 single and 5 double plates of original figures, which, I am glad to say, were all lithographed by Mr. J. Schaumburg, the artist of the Geological Survey, so that they form a well-finished series, although in some of them the negligence of the native printer can be traced.

I have also to refer to the headings of the plates. From a close inspection it will be apparent that the heading "Lower Gondwánas," on about half of the plates (I, III, IV—VI, XIX—XXVI), differs in character and neatness from that on the other plates. The reason is, that those plates were drawn and lithographed last year (1877), when the Karharbári beds were not yet separated from the Damuda series, so that the heading then given was "Damuda Series," which I also gave to the plates representing the Talchir fossils, taking these in close connection with the Karharbári flora. When the separation was made, it was decided to use the more general title Lower Gondwánas, so the original heading on the plates then finished had to be erased, and the new one written over it.

OTTOKAR FEISTMANTEL, M.D.

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THE FOSSIL FLORA OF THE LOWER GONDWANAS.

I.—THE FLORA OF THE TALCHIR-KARHARBARI BEDS,

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According to the latest published information¹ the lower Gondwānas in Bengal consist of three sub-divisions: Panchet, Damuda, and Talchir. The Talchir sub-division, as it is defined now (*l. c.*), comprises the Talchir group of former classifications, together with a certain group of coal-measures called the "Karharbāri beds," and discussed at some length in the paper referred to. A few words upon these deposits and their fossils will suffice here, before proceeding to the systematical description.

Talchir group.—This group of strata was first distinguished by this name in the description of the Talchir coal-field,² and the only organic remains mentioned (*l. c.*, p. 52) were "stems, too imperfect to allow their affinities to be determined," and "annelide tracks," of which specimens were figured on Plate I.

In this field the group is described as unconformable to the Damuda division (*l. c.*, p. 56). Some other fossils are mentioned by Dr. Oldham³ in his paper on "the relations of the rock systems of Central India and Bengal," "a *Phyllothea*(?), a large *Cyclopteris*-like leaf, and some annelide markings." Of these, especially the '*Cyclopteris*-like' leaves are of importance for further comparison. This fossil is more closely indicated by Mr. W. T. Blanford in his description of the Rāniganj field,⁴ where also some other plant remains are mentioned; Mr. Blanford says, p. 39: "Within the Damuda area, the only fossils obtained from the Talchir group have been a few seed vessels and indistinct carbonaceous markings, probably of stems."

¹ Blanford: Rec. Geol. Surv. of India, 1878, Vol. XI, pt. 1, p. 147.

² Mem. Geol. Surv., India, Vol. I, p. 46. But the rocks were mentioned already before: see for this Dr. Oldham's account of the Talchir group in Mem. Geol. Surv., India, Vol. II, p. 307.

³ Mem. Geol. Surv., India, Vol. II, p. 335.

⁴ Mem. Geol. Surv., India, Vol. III.

They were found close to the villages of Gopálpur and Alkúsa, in the west branch of the Nunia river. And in one of the small patches of Talchir beds which dot the country north of the Rániganj field, in that on which the village of Karon stands, a concretion was found containing ferns, of which it is said: (*l. c.*, p. 38), "the best marked was a form intermediate between *Glossopteris* and *Cyclopteris*." This, I think, refers to the "*Cyclopteris*-like" leaf mentioned before; and examination has shown that the form of the leaf and the general disposition of the veins are more like those of a *Cyclopteris*, while the structure of the veins is more like that of a *Glossopteris*, *i. e.*, areolated or anastomosing; there is, however, no distinct midrib in the leaf, and it will be mentioned hereafter as *Gangamopteris*. The labels on the original specimens bear the inscription: Kumar, Purgunnah Saruth-Deoghur, Bheerboom.

Of all the other places where Talchir rocks have been observed, two localities only are noteworthy, as regards fossils. In the description of the Jherria coal-field,¹ Mr. Hughes mentions "indistinct carbonaceous markings" as being abundant in some of the fine argillo-siliceous sandstones in the Khodo, but too indistinct to be recognized. And he says further: "A few impressions were found in the Busjooreen, one of which can be referred to the genus *Glossopteris*." I can form no opinion about this specimen, as I could not find it in the collections.

Much better preserved were ferns which Mr. Hughes procured from the Talchirs in the Káranpura coal-field, of which he says in his Memoir,² p. 296: "In the higher beds of the series, below the junction of the Tordág and Lurunga streams, some well preserved fronds of a *Glossopteris* and *Cyclopteris* were found." These specimens are in our collections, and there is, besides some varieties of *Gangamopteris*, also a specimen which apparently is a *Glossopteris*.

These are all the localities in which Talchir fossils were known to occur. The prominent form of plant was the "*Cyclopteris*-like" leaves, which now are classed with *Gangamopteris*; and the whole list of Talchir plants that will be described further on is the following:—

Schizoneura? an equisetaceous stem—fragmentary.

From the Talchirs of the Karon (Deoghur) area.

Another equisetaceous stem is known from the Káranpura field.

Gangamopteris cyclopteroides, Fstm.³ The original form.

Talchirs of the Karon (Deoghur) area.

Gangamopteris, two other varieties.

From the Talchirs in the Káranpura field.

Gangamopteris, comp. *angustifolia*, McCoy.

From the Káranpura field.

Glossopteris—

One specimen from the Káranpura field. Another mentioned by Mr. Hughes (not in the collections).

¹ Mem. Geol. Surv., India, Vol. V. p. 243.

² Mem. Geol. Surv., India, Vol. VII.

³ Rec. Geol. Surv., India, Vol. IX, pp. 73, 78.

Nöggerathopsis (Nöggerathia) hislopi, Bunb. sp.

From the Talchirs, Deoghur field (Karaon.)

Stems: Talchir coal-field; Karaon area (Deoghur).

Seeds: In the Talchirs of the Rániganj coal-field.

These latter two are hardly of any importance, as they have always been found too imperfect for determination.

There is no occasion to discuss the age or homotaxis of this Talehir group separately, now that it is decided to class it with the Karharbári coal-measures; any age which should be assigned to one must be also assigned to the other.

Karharbári beds.—This name appears for the first time in our group-list in the paper already quoted,¹ to distinguish some coal-measures in the Karharbári field (and elsewhere), which, on account of their palæontological relations, have to be classed with the Talchirs. There is a Memoir by Mr. Th. Hughes² on the Karharbári coal-field; but as at that time the mines were not sufficiently opened, and little or no palæontological material was available, the coal-beds were classed on stratigraphical grounds as "Barákars (Lower Damudas)."

It was early in 1876 that Mr. I. J. Whitty, C.E., Superintendent of the Karharbári collieries, sent to the Geological Museum some splendid specimens of fossils from the mines near Buriadi.

The names of these fossils were given in my first note on the Flora of the Damuda formation;³ they were the following: *Gangamopteris cyclopteroides*, Fstm., *Neuropteris valida*, Fstm., *Voltzia heterophylla*, and *Albertia*; but it was especially the *Gangamopteris* which appeared to me important, "because of the connection it shows between the lower Damudas and the Talchirs" (*l. c.*, p. 73); and I extended the connexion to the whole Damuda formation, considering the Karharbári beds as belonging to it (*l. c.*, p. 78). In January 1877, I was able to visit the Karharbári coal-field, and with the assistance of Mr. Whitty, the Superintendent, and Mr. N. Miller, I made a good collection of fossils. A short note on these fossils was published in the same year,⁴ when I said: "The flora yielded the interesting fact that it is more related to that of the Talehir shales than is the coal flora in any other field (at least as far as brought to notice at present), except the plants from the Mohpáni coal-field;"⁵ and at the conclusion, p. 139, I wrote as follows: "I can determine altogether eighteen species and some varieties. Amongst these are all the plants which are known also in the Talchir shales; besides which there are some triassic types and some local forms. This, I think, tends to show the close connection of the Karharbári coal-strata with the Talchir shales."

¹ Blanford: Rec. Geol. Surv., India, Vol. XI, 1, p. 145.

² Mem. Geol. Surv., India, Vol. VII.

³ Rec. Geol. Surv., India, Vol. IX, Pt. 3 (1876). Here these Karharbári fossils are described with the Damuda flora.

⁴ Rec. Geol. Surv., India, Vol. X, p. 137 (1877).

⁵ The strata of this coal-field are, no doubt, on the same horizon with a portion of the Karharbári beds.

In July 1877, the Karharbári coal-field was visited by Messrs. W. T. Blanford and Th. Hughes; nothing was, however, published on this exploration until the beginning of this year,¹ when the connection of these Karharbári beds with the Talchir was acknowledged by Mr. W. T. Blanford; he writes (page 177) thus: "It appears, therefore, clear that on palæontological grounds, the Karharbári beds must be separated from the Damudas and classed with the Talchirs, and that the distinction is confirmed by differences in mineral character between the Damuda and Karharbári beds."

The following fossils occur in the Karharbári beds; the names only are given, as at present known²; the localities are given in the sequel:—

Schizoneura comp. *Meriani*, Schimp.; *Vertebraria indica*, Royle (Banb.) rare; *Neuropteris valida* Fstm., frequent; *Gangamopteris cyclopteroides*, Feistm., very numerous, with several varieties as *auriculata*, *areolata*, *attenuata*; *Gangamopteris buridica*, Fstm.; *Gang. angustifolia*, M'Coy; *Gangamopt. major*, Fstm.; *Glossopteris communis*, Fstm.; *Glossopteris decipiens*, Fstm.; *Sagenopteris stoliczkanii*, Feistm.

Nöggerathopsis (*Nöggerathia*) *hislopi*, var. *sub-rhomboidalis*; *Euryphyllum whittianum*; *Glossomites stoliczkanus*; *Carpolithes milleri*; *Foltzia heterophylla*, Bgt.; *Albertia*, sp.; Seeds.

Probable existence of the Karharbári beds in the Central Provinces.—As far as is known at present, the Karharbári beds seem to be represented in the coal-fields of the Central Provinces, where also instances of close stratigraphical relations between the Talchirs and the coal-measures were described. There were already in the early collections of the Survey several specimens from Mohpáni, amongst which *Gangamopteris* was prominently represented; and in 1876, Mr. Medlicott brought two specimens from the same locality, which were also *Gangamopteris*.

In January last I had occasion to visit the Mohpáni coal-field, when I collected as many fossils as I could procure; with the assistance of Mr. J. A. Maughan, agent and manager of the Narbada Coal Company's mines, I also observed the stratigraphical relations, and was in both respects very much reminded of the Karharbári beds.

In the original report on the Sâtpura coal-basin,³ the close connexion of the coal-measures and the Talchirs was insisted upon (*l. c.*, p. 149); and in a later description of the Mohpáni coal-field,⁴ the same stratigraphical relation is thus described (*l. c.*, p. 65): "The Talchir group is typically characterized by beds of fine greenish silt or silicious clay and sandstones. The fine earthy sandstones pass up by imperceptible gradation into the Barâkar rock, so that the boundary between them, in the absence of characteristic fossils, must often be arbitrarily assigned." While in the Mohpáni coal-field (1878, January), I reported upon the palæontolo-

¹ Rec. Geol. Surv., India, Vol. XI, p. 145, *et seq.*

² I name the fossils from the three lowest seams only, as the highest (fourth) seam appears to represent the Damuda sub-division, although already in the third seam, *Glossopteris* is more frequent than in the two lower seams.

³ J. G. Medlicott: Mem. Geol. Surv., India, 1859, Vol. II.

⁴ H. B. Medlicott: Rec. Geol. Surv., India, Vol. III (1870), No. 3.

gical relations of the coal-beds there, comparing them with those in the Karharbári coal-field, which view was quoted in the "Annual Report, Geol. Surv. of India," page 5. The fossils from the Mohpáni coal-field, known at present, are only very few; they are—

Equisetaceous stalks, mostly without any indication to which plant they might belong.

Gangamopteris cyclopteroides, Feistm., in different varieties, just like those in the Talchir beds and the Karharbári coal-beds.

Glossopteris communis, Feistm.

Instances of close stratigraphical relation between Talchirs and the coal-measures have also been observed in other places in the Central Provinces. In the report on the Sháhpur coal-field,¹ page 76, the feature is thus described:—"The base of the Barákar group is very vaguely definable as a strict geological horizon. The characters of the two deposits are not only blended vertically by interstratification, but it would appear as if this also occurred horizontally—beds of decided Barákar type in one place being represented by a decided Talchir rock elsewhere."

This stratigraphical evidence in the Sháhpur coal-field seems, partly at least, to be supported by the palæontological relations; the outcrops of the coal seams near Sháhpur are generally very poor in fossil plants; but when in this district in February last, I made a careful search, and the fossils from two localities show a combination that they may well be taken to indicate the Karharbári beds there. These two localities are—

a.—The section near Kotmi, on the left bank of the Machna river, north-east of Sháhpur, where the following fossils were observed:—

Phyllothea ? (equisetaceous stems); *Glossopteris communis*, Feistm.; *Gangamopteris cyclopteroides*, Feistm.; *Nöggerathiopsis (Nöggerathia) kinlopi*, Bunb.; *Carpolithes*.

b.—The section near Dolári, on the Táwa river, east-south-east of Sháhpur, where the following fossils were observed:—

Equisetaceous stalk; *Glossopteris*; *Gangamopteris*; *Nöggerathiopsis*.

A discussion of the localities in these several areas, specially in the Karharbári coal-field, and the distribution of the fossils there, will be given at end of this fasciculus, so as to avoid the mention of names of fossils that have not been described.

¹ Rec. Geol. Surv., India, Vol. XI, No. 1.

² H. B. Medlicott: Rec. Geol. Surv., India, Vol. VIII, No. 3.

SYSTEMATICAL DESCRIPTION OF THE FOSSILS.

According to the plan adopted in my former publications, I give first a list of the fossils to be described:—

NAME.	TALCHER GROUP (TALCHER AND KANHAIRI BASIN).			
	Talcher group proper.	Kanhariri field.	Mohpáni Coal-field.	Shabpur area.
I.—EQUISETACEÆ.				
<i>Schizoneura</i> , comp. <i>Meriani</i> , Schimp.	.....	Passarabhis	.....	.....
<i>Schizoneura</i> ?	Deoghur field	.....	.....	.....
<i>Equisetaceus</i> stalks ... ..	.....	Passarabhis	Mohpáni	Kotmi, Dolári.
<i>Vertebraria indica</i> , Boyle ... ..	.....	Passarabhis	.....	.....
II.—FILICES.				
<i>Neuropteris valida</i> , Feistm. ... ..	.....	Buriadi; Passarabhis; Domahni.	.....	.....
<i>Gangamopteris cyclopteroides</i> , Feistm.	Deoghur field; Káranpara field.	Buriadi, Chunks; Passarabhis; Mithadi.	Mohpáni	Kotmi, Dolári.
<i>Gang. cyclopt.</i> , var. <i>subauriculata</i> .	Káranpara field	Buriadi	.....	.....
" " var. <i>arcolata</i> ...	Káranpara field	Buriadi	.....	.....
" " var. <i>attenuata</i>	Káranpara field	Buriadi	Mohpáni	.....
<i>Gangamopteris</i> ? <i>buriadica</i> , sp. n.	.....	Buriadi	.....	.....
<i>Gangam. major</i> , n. sp. ... ..	.....	Buriadi; Chunks; Domahni; Jogitand.	.....	.....
<i>Gang. angustifolia</i> , McCoy	Deoghur field	Domahni	.....	.....
<i>Glossopteris communis</i> , Feistm.	.....	Passarabhis; Mithadi.	Mohpáni	Kotmi (?), Dolári.
<i>Glossopteris</i> (another species, <i>damudica</i> , MS.)	.....	Passarabhis	.....	.....
<i>Glossopteris</i> , sp.	Káranpara field	.....	.....	.....
<i>Glossopteris decipiens</i> ... ..	.....	Buriadi; Jogitand.	.....	.....
<i>Sagenopteris</i> (?) <i>stoliczkana</i> , Feistm.	.....	Domahni	.....	.....
III.—CYCADACEÆ.				
<i>Glossosamites stoliczkana</i> , Feistm.	.....	Domahni	.....	.....
a.—NÖGGERATHIOPSIDÆ.				
<i>Nöggerathiopsis hialopi</i> , Bunb. sp.	Deoghur field	Buriadi; Domahni; Passarabhis.	Mohpáni	Dolári, Kotmi.

Name.	TALCHIR GROUP (TALCHIR AND KARHARBARI BEDS).			
	Talchir group proper.	Karharbári field.	Mohpini Coal-field.	Shikhar area.
<i>Neggerathispis</i> , var. <i>sub-rhomboidalis</i> .		Domahni; Jogitand	.....	.....
IV.—CONIFERÆ.				
<i>Eryphyllum whitianum</i> , n. sp.		Buriadi	.....	.....
<i>Feltia heterophylla</i> , Bgt., (<i>F. acutifolia</i> , Bgt.)		Buriadi; Domahni; Jogitand (?).	.....	.....
<i>Albertia</i> , sp.		Buriadi	.....	.....
V.—SEEDS.				
<i>Cardiocarpum</i> (?) sp.?		Buriadi	.....	.....
<i>Carpolithes milleri</i> , n. sp.		Pasarlakhia	.....	.....

As the fasciculus treating on the flora of the Damuda sub-division will contain several forms that are also described in the present number, I shall, in order to avoid repetition, speak here at greater length of those forms only which are better represented and more numerous in the Talchir sub-division, postponing the closer discussion of the others for the subsequent fasciculus.

I.—EQUISETACEÆ.

Remains of equisetaceous plants are rather rare in the Talchir sub-division, contrasting conspicuously with the Damuda sub-division; the want of leaved specimens is specially remarkable, those found being mostly equisetaceous stalks. From the Talchirs, however, and from one locality in the Karharbári beds, stalks were procured with fragments of leaf-organs, which, to a certain extent, permit of a comparison with some known forms.

GENUS: SCHIZONEURA, Schimp.

Mougeot et Schimper: Monogr. d. pl. foss. du grès bigarré des Vosges, pp. 48—51.

This genus is especially represented in the Damuda division, and I shall discuss it when describing the plants from that portion of the series.

From the present division I have to record two specimens which, I think, belong to *Schizoneura*.

SCHIZONEURA MERIANI (?) Schimp. Pl. I, figs. 6, 7.

Equisetum meriani, Brgt.: Hist. d. vég. foss., p. 115, Pl. XII, fig. 13.

Calamites meriani, Schenk., in Schoenlein, Abbild. v. foss. Pfl. aus d. Keuper Frankens, tab. V, fig. 4; VI, figs. 1, 2, 4.

Schizoneura meriani, Schimp.: Pal. végét., pp. 252—253, Pls. XV, XVI; Feinstmantel, Rec. Geol. Surv., India, Vol. X, pt. 3, p. 133.

I figure on Plate I, two specimens (6, 7) which represent equisetaceous stalks, rather shortly articulated; the spaces between the joints faintly but broadly ribbed; in the joints there are small, oblong cicatriculæ with an oblong areola. In both specimens there are fragments of leaf organs; they are not quite distinct, but still show that the leaves were linear, prolonged, striated, and, as it appears, inserted on the oblong cicatriculæ. Only these two specimens were found, and although they do not seem quite sufficient for final determination, yet from the characters mentioned they appear to me to be next to *Schizoneura meriani*, Schimp.; I specially refer to Schimper's (*l. c.*) fig. 2, Pl. XV.

I hope some better preserved specimen will decide the matter.

Locality.—Passarabhin, in the Karharbári field, No. 5 D mine, in sandy mica-ceous shales above the bottom seam.

SCHIZONEURA? sp. Pl. I, fig. 1.

In the Talchir rocks of the Deoghur (Karaon) field, together with the *Gangamopteris*, an equisetaceous stalk was found, which has perhaps to be classed also with *Schizoneura*; the stalk is articulated, pretty broadly ribbed, but I find no cicatriculæ in the joints; there are, however, fragments of leaf-organs; as far as I could observe, they do not seem to indicate a spathe continuous round the joint, but they seem to indicate either free leaflets or segments of the spathe like in *Schizoneura*. It would, however, seem safer to postpone a specific identification until better specimens are available.

Other equisetaceous stalks are figured on Pl. I, figs. 4, 5, in which there is no indication whatever of leaf-organs; they are also from Passarabhin, from the same spot as the *Schizoneura? meriani*, and this would, perhaps, permit of the suggestion that they may belong to the same plant.

VERTEBRARIA. Plate I, figs. 8, 9.

Vertebraria is a well known plant in the Damuda division, where it is very numerous through all the strata; the closer discussion will therefore be given in the next fasciculus. The occurrence of this genus in the Talchir-Karharbári beds seems to be very limited, as up to date I know only two specimens from the Karharbári

field which can be referred to *Vertebraria*. They represent the thinner-branched form of this genus; they show the middle axis, and the breaks (foldings) at irregular intervals on the surface, and if we are justified in placing all the Indian *Vertebraria* in one species, *i. e.*, *V. indica*, Royle, there is, I think, no objection to do the same with the specimens under notice.

Locality.—Passarabhis, in the Karharbári coal-field, above the bottom seam.

I have given on Plate I, two other figures (2, 3), which apparently are *Schizoneura*; but they are from the seam on Lumki Hill (on the Komaljore river), which is the fourth seam in the coal-field; and, as the other fossils procured from the same locality show that this seam most probably belongs to the Damuda sub-division, these two specimens are not to be considered as belonging to the flora of the Talchir-Karharbári beds; they were figured on this Plate before the separation was made.

II.—*FILICES*.

Leaves of ferns are rather numerous in these beds, especially in the Karharbári coal-measures in some places, as at Buriadi; the shale is, as it were, packed with fern leaves lying in very thin layers one over the other, so that it is rather difficult to get good specimens without breaking them.

The character of the ferns is also peculiar; they all belong, so far as is known from the material in hand, to single-pinnate fronds, and the prominent portion of them shows an anastomosing venation. Several forms exhibit very large fronds, and we find representatives, especially of two orders:—

Neuropterideæ and *Dictyopterideæ*.

Order: *NEUROPTERIDÆ*.

GENUS: *NEUROPTERIS*, Brongt., 1828.

1828. Hist. d. vég. foss., p. 226.

1844. Schimper et Mougeot: Plantes foss. d. grès bigarré, p. 76.

Ad. Brongniart, who established this genus (*l. c.*), made no distinction in it as regards the frond, and said simply in the diagnosis of the genus: "*Folia bipinnata, vel rarius pinnata.*"

When Prof. Schimper described the fossil plants of the "Bunter" (*l. c.*), he proposed to sub-divide this genus into two groups, one of which should comprise forms with bipinnate fronds, or those from the carboniferous, while the other one should represent the single-pinnate forms, or those from the Bunter. In his Pal. d. végét. foss., Vol. I, he distinguished these two groups with special names, *i. e.*, Sub-genera, *Euneuropteris*: "*fronde bi-tripinnata,*" and *Neuropteridium*: "*frons simpliciter pinnata;*" and in the latter he placed the triassic forms.

Prof. Weiss¹ also uses this name, *Neuropteridium*, but in a quite different sense, although adopting it from Prof. Schimper.

Prof. Schimper's diagnosis was this :—

"*Frons simpliciter pinnata, pinnis integerrimis basi coarctatis, infra medium basin insertis; nervo medio plus minusve distincto.*"

Prof. Weiss writes thus :—

"*Neuropteridium*, Schimp. *Frons composita vel partita; nervus medius distinctus sed evanescens, nervulis parallelis saepenumero aliquot e rachis exorientibus; pinnulae [vel segmenta] tota basi adnatae, partim connatae, non cordiformes.*"

This diagnosis would indicate completely different plants from those which Schimper placed as *Neuropteridium*, and it seems to me that his diagnosis, as the prior one, has the preference.

When first discussing the fossils now under description, I referred them to Schimper's second sub-division—forms with single fronds—and thought myself justified in considering these fossils, in combination with *Voltzia heterophylla* and an *Albertia*, as an important indication for the triassic age of the strata in which they were found. However, as it is not impossible that *Voltzia heterophylla* may occur in Permian strata, the same may be said for this single pinnate *Neuropteris*; for it still remains true that these forms, as far as known at present, are confined to the Karharbári beds, and do not occur in the Damuda sub-division.

SUB-GENUS: NEUROPTERIDIUM, Schimp., 1869.

Pal. végét. I, p. 447.

NEUROPTERIS VALIDA, Feistm. Plates II-VI.

1876. Feistmantel: Rec. Geol. Surv., India, IX, pt. 3, p. 75.

Fronde simpliciter pinnata, valida, longa; rachide crassa, canaliculata striata; pinnulis oblique insertis, inferioribus distantibus superioribus approximatis, stadia tria exhibentibus; imis minimis, oblonge rotundatis, coarctatis, basi decurrente adnatis, margine sinuosis; mediis magnis, oblongis, lobatis an pinnato-incisis, subauriculatis, basi decurrentibus, parte inferiore basis adnatis auricula inferiore superiorem magnitudine superante; pinnulis summis imos forma adaequantibus; pinnula terminali subrhombea, rhachidem terminante, integra aut sinuata. Nervo primario e basi solum distincto, dehinc soluto evanescente; nervis secundariis partim e basi partim e nervo medio ezeuntibus arcuatis repetito furcatis.

It would perhaps appear that I have given more figures of this species than was necessary; but as most of the specimens, on account of the length of the leaf, were not complete, I tried, by figuring the different portions, to give an idea of the whole

¹ Fossile Flora der jüngsten Steinkohlenformation und des Rothliegenden im Saar-Rheingebiete, 1869, p. 28.

plant, thus avoiding an ideal figure of the plant. Amongst all the specimens two only represent the entire frond; they are figured on Pl. III, fig. 1, and Pl. VI, fig. 5; they represent, however, only smaller fronds: fig. 5, Pl. VI, is pretty instructive; it shows the three different forms of the leaflets according to their position in the lower, middle, and upper portion of the frond. The other figures represent different portions of the plant; most of them are lower and middle portions; figs. 1, 2 on Pl. IV, and fig. 1, Pl. V, however, show the top portions of the frond; they show also the terminal pinnula. Unfortunately, the secondary veins in these specimens appear in the print much stronger than they are in reality. Plates V and VI show large specimens of this species. Fig. 2 on Pl. VI, to which fig. 6 belongs as the lower continuation, seems to me to indicate the largest specimen; the rachis is very thick, the lower pinnulae pretty large, and the upper ones profoundly lobated, so I conjecture that the figured specimens show only one-half of the entire frond. Fig. 1, Pl. VI, also seems to indicate a large frond.

The insertion of the leaflets and the venation.—The lower leaflets are of a more oblongly rounded form, but yet apparently decurrent; the middle vein is slightly indicated. The middle leaflets are pretty oblong, either lobated or in larger specimens deeply incised; at the base they are constricted and auricled, the lower auricle is larger than the upper one; the base is decurrent into the rachis, and they appear inserted on the lower portion of the base; the midrib originates from this part, continues, although faintly, up to the middle of the leaf, whence it is resolved into the secondary veins. These veins pass out partly from the constricted base, partly from the midrib; they are arcuate, and divide into many branchlets.

The upper leaflets resemble the lower ones, and the top leaflet is obliquely rhomboidal, with obtuse angles.

Some of our forms recall Schimper's *Neuropteris grandifolia* (Schimp. et Moug., l. c., Pl. XXXVI, fig. 1); but the leaflets in this are much closer, their substance much thinner, and they do not appear so deeply lobated or incised.

Locality.—Very common at Buriadi, mine No. 11A, above the bottom seam; also at Passarabhia, mine No. 5D and 5G, above the bottom seam; found also at Domahni.

Order: DICTYOPTERIDÆ.

Representatives of this order are most numerous amongst the specimens from the Talchir-Karharburi beds. And it was through a form of this order that the affinity of the deposits was first suggested.

GENUS: GANGAMOPTERIS, McCoy.

Fronde simplici (an impare pinnata ?); *forma variabili, nunc ocali, latiuscula, nunc obovato-elongata basi, attenuata amplexicauli an subauriculata*¹, *nunc lanceolato-spathulata, truncata; nervo medio nullo, nervis radionibus, anastomosantibus retia formantibus. Fructificatione non obvia.*

1847. *Cyclopteris* ? McCoy : Ann. and Mag. Nat. Hist., 20, tab. 10, 3, 3a.

1875. McCoy : Prodr. Pal. of Victoria, Decade II, p. 11.

This peculiar kind of fern was first made known from New South Wales in 1847, when Prof. McCoy, in his paper on Australian fossils (*l. c.*), described a fern as *Cyclopteris ? angustifolia*, from a single leaflet "having the form and netted venation of the narrow varieties of *Glossopteris broseuiana*, but which appeared generically distinct from wanting the midrib," and although referring the plant doubtfully to *Cyclopteris*, he pointed out the apparently generic difference in the anastomosing of the veins. Later, Prof. McCoy examined a great number of specimens from the Bacchus-Marsh sandstone in Victoria in which this anastomosing of veins and wanting of a midrib were marked and constant characters, so that he established a new generic name for them, *Gangamopteris*. He described altogether three species:

Gangamopteris angustifolia, McCoy, from the Newcastle-beds and the Bacchus-Marsh sandstone.

Gang. spathulata, McCoy, from the Bacchus-Marsh sandstone.

Gang. obliqua, McCoy, from the same locality.

The Indian Talchir and Karharbâri beds have also yielded a good number of fern leaves with the characters of *Gangamopteris*, so that I refer them to this genus. There are several species and several varieties of one species.

GANGAMOPTERIS CYCLOPTEROIDES, Feistm. Pls. VII, IX, XI, figs. 2, 3, 4; X, fig. 3; XII, figs. 2, 3; XIII, figs. 1, 5; XXVI, figs. 1, 3; XXVII.

1876. Feistmantel : Rec. Geol. Surv., India, pp. 75, 78.

Fronde oblonge ocali symmetrica an subobliqua, integra; rhachide nulla, nonnullis nervis crassioribus solum indicata; nervis e basi radiantibus (cyclopteridis instar), anastomosantibus retia longiuscula ac latiuscula media in folii parte, sed angustissima marginem versus formantibus (Glossopteridis instar). Basi attenuante, amplexicauli.

This was the first described species from the Talchir group and from the Karharbâri coal-beds. But later some other forms were discovered, which agree with the original species in general arrangement of the veins, but differ more or less in

¹ The addition of this character is explained further on.

the shape of the leaf and in the form of the base; so that, not wishing to distinguish them as different species, I shall describe them as varieties only.

The present form is more or less broadly ovate, and has, as it appears, an entire margin; there is no midrib, and it is indicated in the lower portion only by several thicker veins, which, however, show the same character as the others, *i. e.*, that they diverge into the leaf and are anastomosing. The areolæ are pretty long, and of a certain breadth in the middle and towards the base of the leaf, while they become narrow towards the periphery. This form shows the closest relation to Prof. McCoy's *Gangamopteris obliqua*,¹ from the Bacchus-Marsh sandstone, which is also described by Prof. McCoy as being the most variable and common of the three forms described by him. In India this form is known both from the Talchir and Karharbâri beds.

Localities.—I have figured several specimens from different localities. Plate VII: two specimens of the broad form, from the Karaon field, in hard bluish-grey shale. Plate IX, figs. 2-6: smaller specimens of the same species from the same locality. Plate X, fig. 3: a very small specimen, which, as I believe, belongs to the same species. Plate XI, figs. 2, 3, 4: portions of the same species in greenish-grey, soft sandy shale from the Kâranpura field. Plate XII, figs. 2, 3: from the Karharbâri beds in the Karharbâri coal-field, from No. 11 A mine at Buriadi, above the bottom seam. Plate XIII, fig. 1: from Mâthadi; fig. 5: from Passarabha, Karharbâri field, from No. 5 D mine, above the bottom seam. Plate XXVI, fig. 1 (3): from the Karharbâri beds, in the Karharbâri field, from Buriadi, No. 11 A mine. Plate XXVII, figs. 2, 3: from the Mohpâni coal-field. Besides these, the species is known from Chunka and Mâthadi in the Karharbâri field, and from Kotni in the Shâhpur area. Also near Dolâri (Shâhpur coal-field) a *Gangamopteris* was found.

GANGAMOPTERIS CYCLOPTEROIDES VAR. SUBAURICULATA. Pl. X, figs. 1, 1 a, 1 b; Pl. XIII, fig. 2; Pl. XV, figs. 1-3; Pl. XVI, fig. 3.

Fronde longissima ovali, apice obtuse acuminata; nervo medio nullo nonnullis nervis crassioribus indicato; nervis media ex parte radiantibus, anastomosantibus retia longa formantibus; basi subattenuata, angulis basalibus rotunde auriculatis.

The leaves of this form are distinguished by their proportionally greater length, while the characters of the distribution of the veins are the same as in the typical *G. cyclopteroïdes*; the form of the base, however, establishes the difference; the leaf becomes a little narrower towards the base, which itself at the angles gets broader again and is roundly subauriculate. This variety exhibits the longest leaves. I refer especially to fig. 2, Plate XV; and as exhibiting well the auriculate base, to figs. 1, 3, Plate XV.

¹ *Prodr. Pal. Vict.*, Dec. II, Pl. XII, figs. 2, 3, 4.

I am well aware that Prof. McCoy, in giving the generical character of *Gangamopteris*, said, that the base is never auriculate; but there is, I think, also no doubt that our leaves just described, in spite of the subauriculate base, have all the characters of *Gangamopteris*, so that this character can hardly justify a separation of these leaves from *Gangamopteris*. I have therefore taken this character into the diagnosis of the genus.

Locality.—Talchir beds in the Káranpura coal-field (Plate X, figs. 1, 1a, 1b); from the Karharbári beds in the Karharbári coal-field at Buriadi; (Plate XIII, fig. 2; Plate XV, figs. 1-3; Plate XVI, fig. 3).

GANGAMOFT. CYCLOPTEROIDES VAR. AREOLATA. Pl. X, fig. 2; Pl. XVI, fig. 4.

Folia elongatis, forma folia var. auriculata adæquantibus, basi subauriculatis; nervis radiantibus, in parte basali retia polygonalia, nitida, parte superiore angusta ac elongata formantibus.

This form differs from var. *subauriculata* by the base being scarcely auriculate, and by the basal lateral veins forming a nice polygonal net-work, while the arcolæ in the upper portion are long and narrow like in the other forms.

Locality.—One specimen was found in the Karharbári beds of the Karharbári field, at Buriadi, No. 11A mine (Pl. XVI, fig. 4), and one fragment in the Talchir shales of the Káranpura coal-field (Plate X, fig. 2).

GANGAM. CYCLOPTEROIDES VAR. ATTENUATA. Pl. XI, fig. 1; Pl. XII, fig. 1; Pl. XIII, fig. 3; Pl. XIV, figs. 1, 2; Pl. XVI, fig. 5; Pl. XXVII, fig. 1.

Fronde oblonge an ovato-spathulata, basi attenuata, amplexicauli, acuminata; nervis mediis inferiore in parte crassioribus, dehinc subarcuate radiatum eggregredientibus, retia longa et angusta formantibus.

The leaves have the same distribution of veins as *Gangamopteris cyclopteroides*, but the leaf is a little longer, and becomes much narrower towards the base, which is encircling. Some of the middle veins are thicker in the basal portion of the leaf, whence the other veins pass out, forming oblong narrow nets.

Locality.—From the Talchir beds in the Káranpura field (Pl. XI, p. 1); from the Karharbári beds at Buriadi, Karharbári field (Pl. XII, fig. 1, Pls. XIV, figs. 1-2, XVI, 5); and at Máthadi in the same coal-field (Pl. XIII, fig. 3). Also from Mohpáni coal-field (Pl. XXVII, fig. 1).

GANGAMOPTERIS (?) BURIADICA, n. sp. Pl. XVIII, figs. 1-2, 2a.

Fronde pinnata, foliis lanceolato-spathulatis, truncatis; nervis e basi attenuata nonnullis crassioribus radiatim egredientibus, dehinc furcatis et anastomosantibus, retia longissima angustaque formantibus, recte radiantibus.

Amongst the plants from the Karharbári beds there are some leaves which by the radiary disposition of the veins, and their anastomosing, belong apparently to the genus *Gangamopteris*, but the shape of the leaf is conspicuously different. The leaves are lanceolate-spathulate, pretty long, broader and obtusely rounded at the apex, and narrower at the base. The veins pass out from the attenuate base as several strong veins, which are soon divided into branches, which, however, are anastomosing again, and form long and narrow, straightly radiating nets. By this straight radiation of the veins the present form differs from those mentioned before, so that I think it well represents a new species.

The form of the leaf, with the very attenuate base, would indicate perhaps that these leaves belong to a pinnate frond, which of course can only be proved by direct observations. For the present, it may be sufficient to establish the difference of this form from the others.

Locality.—In the Karharbári beds at Buriadi, Karharbári field, No. 11A mine.

GANGAMOPTERIS MAJOR, sp. n. Pl. XIV, fig. 3; Pl. XVI, figs. 1-2, 2a.

Foliis spathulatis apice acuminatis an obtusis, basi angustatis, margine integerrimis; nervis in parte basali attenuata nonnullis, ex quibus ceteris furcatione orientibus, anastomosantibus, recte radiantibus, retia oblonge-angusta formantibus.

The distribution and direction of the veins in this species is very similar to that in the previous species (*G. buriadica*), the form of the leaf, however, being totally different, i. e., regularly spathulate. The basal portion is pretty narrow. In this portion there are only few veins, and they are straightly radiating, which is also the case with the others originating from them by repeated division; they are anastomosing and form long and narrow nets.

This form recalls in some degree Prof. McCoy's *Gangamopteris spathulata*¹ but our leaves are larger, and the veins are from the base completely and straightly radiating, while in McCoy's species they radiate arcuately, from the base up to the apex.

I have given three figures, of which fig. 2, Pl. XVI, is not so large as the others, and also has an obtusely rounded apex, while the two others show their apex obtusely pointed. I do not, however, think it necessary to separate this specimen from the others, as the distribution and direction of the veins is the same in all the figures.

¹ Prodr. Pal. of Victoria, Dec. II, p. 12, Pl. XIII, figs. 1, 1a.

Locality.—All three figured specimens are from the Karharbári beds in the Karharbári coal-field, at Buriadi, No. 11A mine; besides this the species is known from Chunka, Domahni, and Jogitand.

GANGAMOPTERIS ANGUSTIFOLIA, McCoy. Pl. IX, fig. 5.

1847. *Cyclopteris angustifolia*, McCoy, An. and Mag. Nat. Hist., Vol. XX, tab. 19, figs. 3, 3a.

1875. *Gang. angustifolia*, McCoy, Prodr. Pal. Vict., Dec. II, p. 11, Pls. XII, fg. 1, XIII, fg. 2.

Two leaves from the Talchir and Karharbári beds were determined as *Gang. angustifolia*, McCoy; as to the description I must refer to McCoy's original papers, where this species is sufficiently treated of. I have figured only this specimen from the Talchir shale.

This form seems to be pretty frequent in Australia, and was described by McCoy from Guntawang Mudgee, New South Wales, and from the Bacchus-Marsh sandstone in Victoria.

Locality.—In the Talchir beds of the Deoghur (Karmon) field, and in the Karharbári beds, at Domahni, in the Karharbári field.

GENUS: GLOSSOPTERIS, Brongt., 1828.

This genus is disproportionately numerous in the Damuda division of the lower Godwánas, and it will therefore be discussed as fully as necessary in the next fasciculus. In the present paper I have to describe three species only, two of which, however, also occur in the Damuda division, where they are more frequent.

GLOSSOPTERIS COMMUNIS, Feistl. Pl. XVII, figs. 1, 2, 2a.

1876. Feistmantel; Journ. As. Soc. Bengal, Vol. XLV, p. 375.

Fronde simplici plerumque speciosa, integerrima ovato-oblonga apice obtuse ac elongato acuminata, basi attenuata, rachide crassa usque ad apicem producta; nervis lateralibus teneris, sub angulo acuto egredientibus, retia oblonga, angustissima rachi proxima latiuscula formantibus.

This is a very common form in the Damuda division, where it is found through all the beds and at most of the localities. It attains generally a pretty large size (younger leaves of course being smaller); it is oblongly, sometimes, however, more obtusely, acuminate at the apex, and narrowing towards the base; the rachis is rather thick, and from this the secondary veins pass arcuately at pretty acute angles; close to the rachis the veins are a little thickish; further on they are thin, anastomosing, and form long and narrow nets. To show the venation I have enlarged a portion in fig. 1a, Pl. XVII.

I shall have occasion to mention this species again when describing the form of the Damuda division, when more specimens will be figured.

Locality.—Karharbári beds at Máthadi, No. 1 shaft, in the Karharbári field (Pl. XVII, figs. 1, 2), and at Passarabha, above the bottom seam, in the same field. Also in the Mohpáni coal-field, and at Kotmi, Shápúr area. More frequently in the Karharbári field at Passarabha, Nos. 17B and 17C mines, above and within the third seam.

GLOSSOPTERIS (*damudica* Ms.)

From the shaft No. 17C, at Passarabha (see further on), besides the *Glossopteris communis*, there is another species known elsewhere only in the Damuda sub-division, from which it was obtained long before the fossils at this place were discovered.

It is a leaf with a distinct rhachis, the veins passing out from the same in an approximately straight direction; they form anastomoses, the meshes being broad and oblongly polygonal towards the rhachis, and becoming narrower by repeated furcation towards the margin, preserving, however, their shape. The leaves attain sometimes a very large size.

I do not publish the description of this form here, as it is more frequent in the Damuda sub-division, but in my manuscript notes I have called it *Gl. damudica*, which name, I think, I shall retain even now after it has been discovered in the Karharbári coal-field; the shaft No. 17C works the third seam, and this *Glossopteris* is from the shale above this seam, which, however, as I explain at end of this paper, is still to be considered as belonging to the Karharbári beds in the Karharbári coal-field.

GLOSSOPTERIS DECIPiens, sp. n. Pl. XVIII, figs. 3, 4, 5; Pl. XXIV, fig. 6.

Fronde anguste spatulata basi paulum attenuata, angulis basilaribus subauriculatis; costa inferiore in parte folii crassiuscula, apicem versus evanescente in nervos secundarios soluta. Nervis secundariis e basi rhachideque arcuatim egredientibus in portione apicali radiatim dispositis, omnibus anastomosantibus retia oblonga angusta formantibus.

The leaf is oblongly spatulate, with a slightly narrowed base; the basal angle seems to have been rounded or slightly auriculate. The midrib is thickish, but runs up only about to two-thirds of the leaf, whence it disappears, and is resolved into the secondary veins. This character is the more remarkable, as this form, although a *Glossopteris*, resembles, on the other hand, in the top portion of the venation, a *Gangamopteris*. The secondary veins pass out arcuately from the base and from the rhachis, are anastomosing, and form oblong and narrow meshes.

I would feel inclined to consider this form as transitional between *Glossopteris* and *Gangamopteris*.

■

Locality.—In the Karharbári beds at Buriadi, No. 11A mine, in the Karharbári field; also at Jogitand, No. 2 shaft.

GLOSSOPTERIS, sp.

As I mentioned before, a *Glossopteris* was also found in the Talchir shales of the Káranpura coal-field, but the veins are not quite distinctly preserved, so that it does not quite well permit of final specific determination; the midrib, however, is very distinct, and there is no doubt about the specimen being a *Glossopteris*.

SAGENOPTERIS (?) STOLICZKANA. Plate XIII, fig. 4.

1876. Rec. Geol. Surv., India, Vol. IX, pt. 4, p. 139.

From the relative position of two leaves on one specimen I consider them to be connected, forming so a fingered leaf. The longer of the two appears to me as the middle portion, while the other one would represent a lateral leaf. There is no marked midrib, although in the basal portion there is an indication of it. The secondary veins pass at a very acute angle into the surface of the leaf, and are anastomosing, forming oblong, acutely-angled meshes. I think *Sagenopteris* is the only genus which this specimen can be referred to.

Locality.—Karharbári beds at Domahni, in the Karharbári field.

Fern-rhizome.¹—On Plate XIII, fig. 6, a specimen is figured, which appears as the impression of a stalk, with rhomboidal markings on the surface. These markings do not seem to be disposed in any fixed order, although a generally spiral arrangement can be recognized. The markings (cicatriculæ) themselves are of a different size, but oblongly rhomboidal in outline.

It appears to be the subterraneous vegetative organ (rhizome) of a fern. If we consider the rhomboidal scars, and if we assume that it belongs to some of the described ferns, I would be inclined to consider it as belonging to *Neuropteris valida*, Fstm., the stalks of which have the thickness required to leave, after their detachment, the rhomboidal scars exhibited on the surface of the figured specimen.

Locality.—Buriadi, No. 11A mine, Karharbári coal-field, Karharbári beds.

III.—CYCADEACEÆ.

GENUS: GLOSSOZAMITES, Schimper.

1870-72. Schimper: Pal. végét., Vol. II, p. 163.

This genus was established by Schimper from a form of *Pterophyllum* and some forms of *Podozamites*. Two impressions belonging to one and the same leaf, from

¹ It is known that recently Fern-rhizomes were described with the generic name *Rhizomopteris*, and there were even species established with this name. I share completely the view of the authors of this method, although it is not approved of by others, for the name *Rhizomopteris* means just as much as Fern-rhizome.

the Karharbári beds, appear to me to represent this genus, although they in one point do not agree quite with Schimper's diagnosis; this refers to the symmetrical shape of the leaflet; but the *Glossozamites schenki*, which is figured by Heer,¹ also shows an oblique (or at least inequilateral) shape of the leaflets, so that the slightly oblique form of the Indian specimen would not be any objection to its being classed with *Glossozamites*, while the other characters agree.

Glossozamites, as known at present, has its representatives in liassic (1 species = *Glossoz. oblongifolius*, Kurr., sp.), and in cretaceous rocks (4 species = *Glossoz. zitteli*, Schenk, sp., *Gl. Hoheneggeri*, Schk., sp., *Gl. obovatus*, Schk., sp., and *Gl. schenki*, Heer). I think that this at present known geological range of the genus can likewise be no objection to my considering the Indian leaf a *Glossozamites*. The largest leaflets at present known are those of *Glossozamites zitteli*, Schenk, sp.

We could, of course, class our specimen also with *Podozamites*, but as Prof. Schimper separated those forms, to which our specimen is closely allied, as *Glossozamites*, I think it more correct to follow his classification.

GLOSSOZAMITES STOLICZKANUS, *Fstm.* Plate XX, figs. 4, 5.

1876. Feistmantel: Rec. Geol. Surv., India, Vol. IX, pt. 4, p. 142.

Frondis forma magnitudineque ignota. Foliis elongato ovalibus validis, 8 cm. longis, 23 mm. latis; media in parte latissimis apicalem partem versus attenuatis rotundatis; parte basali æquali modo angustata, angulis basalibus obtusatis; foliis tota basi (?) an media in parte basia (?) insertis; nervis crebris e basi recte divergentibus, semel bisque furcatis.

There is only one leaf known, of which both the positive and negative impressions are preserved and figured on Plate XX. I think the shape and base of the leaflet shows evidently that it belongs to a pinnate leaf, which was distichous; the lingulate form is also conspicuous, and the distribution of the veins agrees with the description given by Schimper for *Glossozamites*.

There is, I think, also little doubt that this form is a *Zamia*.

If my identification is correct, then this form is the largest known *Glossozamites*.

The veins pass out from the whole base, are straightly divergent, and once or twice forked; only those veins close to the basal angles pass, slightly arcuated, to the margin.

Locality.—This leaf (Pl. XX, figs. 4, 5) is from the Karharbári beds at Domahni, in the Karharbári coal-field.

a.—NÖGGERATHIOPSIDE.E.

(NÖGGERATHIE.E exp.)

(CYCADEACE.E AN CONIFERE.E?).

In the Talchir-Karharbári beds, and more frequently in the Damuda division of the Indian coal-bearing rocks, there occur certain oblong and spatulate leaves with *straight, slightly diverging, and distinctly once or several times bifurcate* veins, fragments of which were doubtfully classed with *Nöggerathia*¹ by the first describer, Sir Ch. Bunbury, and since then these leaves were quoted with this name. I myself considered these leaves at first as *Nöggerathia*, classing them with the *Zamia*.

But last year when examining these Indian leaves more carefully, and comparing them with the descriptions by Weiss and specially by Prof. Heer, which were not at my disposal when writing my first notes on this subject, I arrived at the conclusion that these Indian leaves cannot possibly be identified with *Nöggerathia*, and I compared them with *Zamia*. In a communication to the Geological Magazine, dated 11th May 1877,² I wrote: "I wish to state that our *Nöggerathia* from the Damuda series" does not agree with the genus as defined by Schimper, Weiss, and more recently by Prof. O. Heer; I have allowed the name to stand as a matter of convenience. Our *Nöggerathia* is more allied to *Zamia* than to any other genus." In order to explain this statement further, it will be well to discuss briefly the recent views about the *Nöggerathia*, to show how far our Indian leaves, supposed to be *Nöggerathia*, are different from *Nöggerathia* in the proper sense.

As regards the systematical position, so much appears certain at present—that the *Nöggerathia* belong to the *Gymnosperms*, a class which especially includes the *Cycadeaceæ* and *Conifera*. Sternberg classed *Nöggerathia* with the *Palme*, Göppert with the ferns, as did Unger. Brongniart, however, considered it closely allied with the *Cycadeaceæ*; Sir Ch. Bunbury, who first described the Indian form, although mentioning the possibility of its being a fern, was rather inclined to refer it to the *Cycadeaceæ* or a neighbouring family. But this classification, like my own, refers to leaves which cannot be classed with *Nöggerathia*, although they may probably belong to *Cycadeaceæ*.

Prof. Geinitz adopted the classification of Brongniart. Schimper, in his Pal. végét., placed *Nöggerathia* with the *Cycadeaceæ* (*Zamia*); Saporta also quotes *Nöggerathia* amongst the *Cycadeaceæ*, and it was on the authority of these authors (as the most recent ones) that I, considering our Indian leaves also as *Nöggerathia*, insisted on their belonging to the *Cycadeaceæ*. We shall, however, see

¹ Quart. Journ. Geol. Soc., Vol. XVII: Fossil plants from Nagpore.
Geol. Magazine, 1877, pp. 431-432.

² With which at that time I included the Talchirs as well as the Karharbári coal-beds.

that our leaves have to be eliminated from the characteristic forms of *Nöggerathia*, and have to be placed elsewhere.

I have, however, to refer specially to some remarks of mine upon this subject. In the Geol. Magaz., 1876, p. 489, I wrote as follows:—"Cycadeous plants are not absent at all; on the contrary, Sir Ch. Bunbury's *Nöggerathia hislopi* has its place here; and I determined besides this another *Nöggerathia* from the South Godavari District as very near, if not quite identical with, the *Nöggerathia vogesiaca*, Bronn, and lately a *Glossosamites*, Schimp. . . ." With this statement I referred the fossil which Sir Ch. Bunbury called *Nögg. hislopi* to the *Cycadeaceæ*, without stating that Bunbury himself had done so, and without noting that all *Nöggerathieæ* belong to the *Cycadeaceæ*. As regards *Nögg. vogesiaca*, I refer to the literature (Bronn, Schenk, and Schimper), specially to Schimper's Pal. végét., where it is described as *Macropterygium* amongst the *Zamia*; as regards *Glossosamites*, the name itself is an explanation.

In a subsequent paper, 1877, Rec. Geol. Surv.,¹ p. 72, I wrote as follows:—"The resemblance of *Nöggerathia* in its well defined characters with some *Zamia* is so striking, that there can be little doubt but that it belongs to this order or very near." This statement was supported by the following:—"If we compare the carboniferous *Nögg. foliosa*, Stbg., with *Sphenozamites rossi*, Zign., there is certainly a great similarity between them. . ." The comparison was made also by Schimper, who added still as another reference the cycadeaceous genus *Podosamites*. I said further on:—"Our *Damuda Nöggerathia* resembles very much the leaves of some living *Zamia*, so that all evidence seems to prove the views of Brongniart that *Nöggerathia* is a *Cycadeaceæ* and most probably a *Zamia*." This statement was made, considering specially our Indian leaves, which, however, as I shall show presently, after closer examination appear not to belong to *Nöggerathia*.

After the short paper referred to in the Records was written, two publications came to my hands which treated on the *Nöggerathieæ*, and which shewed me that the Indian leaves under description do not belong to this family, and which also opened new views of the systematical position of the *Nöggerathieæ*. Each of these papers, however, assigned to them a different place in the system.

The one is Prof. Weiss' paper on the Fossil Flora of the Saar-Rhine basin,² and the *Nöggerathieæ* are discussed in No. 2, p. 189, *et seq.* Although this fasciculus was published already in 1871, our Library did not get a copy until the 23rd of August 1877, so that, although having heard of the work from Europe, I could not refer to it. Prof. Weiss places the *Nöggerathieæ* doubtfully with the *Monocotyledoneæ*; from his diagnosis I shall repeat only those sentences referring to the leaves (p. 189):—"Folia parallelinervia plerumque magna cuneata vel elongata parallelis marginibus, ramo transverse inserta, biserialia alternantiaque aut spiral.

¹ Vol. X, pt. II.

² Fossile Flora der jüngsten Steinkohlenformation und des Rothliegenden im Saar-Rheingebiete.

iter disposita, demum approximata; Nervi numerosi æquales vel crassiores et tenuiores, simplices nec dichotomi sed aliis interpositi."

The veins are equal (*Nöggerathia*) or alternately thicker and thinner, *simple, not forked*, but increasing their number by interposition between others. The type is *Nöggerathia foliosa*, Stbg. In this character of the veins lies the chief difference of our Indian leaves from *Nöggerathia*; I examined our leaves, and they show *distinctly forked veins*.

As regards the insertion of the leaves, our specimens do not admit of a conclusive judgment; but the rigid appearance of the leaves, their somewhat oblique shape, and then one specimen from Barkoi (Satpura basin) which shows two leaves as it were in their natural position, as they were inserted on the stalk, would make us suggest that the leaves were distichous on a common stalk, and *not spiral*, as it appears in another Indian form, which I describe as *Euryphyllum*, gen. n.

It appears therefore that with reference to Prof. Weiss' description, our Indian leaves are different from *Nöggerathia* in his sense, nor can they be Monocotyledonous.

That the *Nöggerathieæ* (in the proper sense) cannot be *Monocotyledones* was shown by Prof. Heer in his "Beiträge zur fossilen Flora Spitzbergens," and there remained the Gymnosperms only with which they could be classed.

Prof. Heer concludes his discussion of this point with the following sentence (p. 19): "From the facts mentioned we conclude that the *Nöggerathieæ* form a peculiar family of the coal period, belonging to the order of *Coniferae*. It probably effects the passage to the *Cycadeaceæ*; and *Ginkgo* and *Phyllocladus*, also perhaps *Wolkeitschia*, form the links between those coal plants and the present creation."

But from his classification, given in the same paper, it will be seen that our Indian leaves cannot be identified with any of the three genera which Prof. Heer characterises as follows:—

1. "*Nöggerathia*, with distichous leaves, which are cuneiform at base, and contain numerous equally strong veins which are radiarily diverging.
2. *Rhynchogonium*, with spirally (?) disposed leaves, which have parallel margins and are not, or only slightly, narrower at base, with numerous equally strong longitudinal veins, which are parallel, with rostrate fruits ribbed in the rostrum.
3. *Cordaites*, with spirally disposed leaves, with parallel margins, only slightly narrower at base, with parallel unequally strong longitudinal veins."

¹ *Flora fossilis arctica*, Vol. IV, 1877, which arrived in Calcutta on the 2nd of May 1877.

² Aus den vorliegenden Thatsachen schliessen wir, dass die *Nöggerathieæ* eine eigenthümliche, der Steinkohlenzeit angehörende Familie bilden, welche zur Ordnung der Coniferen gehört. Sie dürfte den Übergang zuden Cycadeen vermitteln und *Ginkgo* und *Phyllocladus*, vielleicht auch *Wolkeitschia* sind wohl die Aushängepunkte dieser Steinkohlenpflanzen an die jetzige Schöpfung."

³ 1. *Nöggerathia* mit zweizeilig geordneten Blättern, die am Grunde keilförmig verschmälert sind und zahlreiche gleich starke Längsnerven haben, die strahlenförmig auseinander laufen.

2. *Rhynchogonium* mit spiralg gestellten (?) Blättern, die parallelseitig, am Grunde nicht oder nur wenig verschmälert, mit zahlreichen gleichstarken Längsnerven, die parallel verlaufen und mit geschnabelten, im Schnabel gerippten Früchten.

3. *Cordaites* mit spiralg gestellten Blättern, die parallelseitig am Grunde nur wenig verschmälert, mit ungleichstarken, parallelen Längsnerven."

If we compare with these the description of the Indian leaves and the figures, we shall find that they are different from all three forms. It would be therefore quite inappropriate to use for these Indian leaves the name *Nöggerathia*, as this name would convey a wrong idea on the character and nature of these leaves, nor can they be placed with the *Nöggerathia* altogether.

In order, however, to retain for these leaves something of the former denomination, I propose to establish for them the family name *Nöggerathiopsidae* with the genus *Nöggerathiopsis*, placing them at end of the *Cycadeaceæ*, for so long as their proper position is not more conclusively established.

The family *Nöggerathiopsidae* is therefore characterised as follows :—

Foliis Nöggerathiarum foliis similibus nervis crebris e basi egredientibus, crassiusculis dehinc furcatis.

GENUS—NÖGGERATHIOPSIS, nov.

(NÖGGERATHIA—*ex parte*.)

Foliis biserialibus (?) e basi cuneiformibus an elongato epathulatis an subrhombicis marginibus rectis an paulo subincurvatis; nervis crebris, e basi crassiusculis, deinde bis pluries furcatis in folium divergentibus, tenuibus.

This genus comprises all the Indian leaves formerly mentioned as *Nöggerathia*, the distribution of which goes through all the strata from the Talcchirs up to the Kamthis, from the latter of which they were first described. So long as contradictory evidence is not found, I feel inclined, regarding the rigidity of the leaves, their shape, and the character of the veins, to consider these leaves as of cycadaceous plants, and the living forms, *Eucephalartos*¹ and *Zamia*,¹ and the fossil *Podozamites*, may represent their analogues.

NÖGGERATHIOPSIS (*Zamia?*) HISLOPI—*Bunb.*, sp. Pl. XIX, figs. 1-6; Pl. XX, figs. 1, 1a.

1861. *Nöggerathia ? (Cyclopteris?) hislopi*: Quart. Journ. Geol. Soc., Lond., Vol. XVII, p. 334, Pl. X, fig. 5.

Sir Ch. Bunbury's figure (*l. c.*) represents a very fragmentary specimen from which it would scarcely be possible to recognize the species again. But from his descriptions it can be seen that he had several portions before him from which he formed the diagnosis; and there are also in the Geological Museum several specimens of this fossil in the collection from the Nagpur district, so that there is no doubt in identifying this plant from other localities. Sir Ch. Bunbury gave the following description (*l. c.*, p. 334).

¹ *Saporta*: Pal. franc., 1873, No. 11. *Végét.*, Pl. LXXIV, figs. 1-3, 4.

"The leaf was of a narrow wedge-shape, widening gradually upwards from a narrow base, not, however, quite symmetrical, but very slightly oblique, the terminal portion, which is well seen in one fragment, very conspicuously oblique, rounded at the actual apex, and thence sloping away with a gentle curve and forming a very obtuse and rounded angle with the other (lower) margin. The leaf (as far as can be judged from mere impressions) appears to have been of a firm and rather rigid texture, with a smooth surface. The largest fragment I have seen is about 5½ inches long, the breadth in no part seemingly much exceeding 1 inch. Veins numerous, all equal and uniform, with no appearance of a midrib, strong and rather coarse, radiating from the base, but spreading very gradually and forming a very small angle with one another, so that for any short distance they appear nearly parallel, they are once and twice forked, but very sparingly, the branches diverging very gradually and all end in the terminal margin."

This description of Sir Ch. Bunbury is pretty well applicable to the leaves I have figured in the present paper, specially as regards the shape of the leaf and general character of the veins. But if we examine the veins closer, we shall find the following: The veins pass out, about equally strong, from the base (as is specially exhibited in fig. 6, Pl. XIX, and fig. 1, Pl. XX); close above the base they are forked, and then several times again, at different intervals in the length of the venation. According to the shape of the leaf, the veins are diverging and much thinner in the apical portion.

The shape of the leaf, as described by Sir Ch. Bunbury, is generally more or less oblique. The most complete leaf I have observed is figured Pl. XX, fig. 1; it is also the longest, measuring about 6½ inches, and about 1½ inches in breadth; all the leaves are detached, and none of them show the base preserved.

Localities.—One leaf is known from the Talchir shales of the Deoghur (Karoon field) figured Pl. XIX, fig. 1. It is very fragmentary, and the outline is restored, but I think the apex is made rather too obtuse. In the Karharbári beds of the Karharbári coal-field these leaves are more numerous, the figured specimens Pl. XIX fig. 2, 6, and Pl. XX fig. 1, are from Buriadi, No. 11A mine; besides these the species is known from Passarabhia. It occurred also near Kotmi and Dolári in the Sháhpur area, and in the Mohpáni coal-field.

On Pl. XIX fig. 3-5, I have figured three smaller specimens of leaves which show all the characters of the others, just described as *Nögg. hislopi*, but differ from them by their size; they are much smaller, they show well the oblique shape, the apex, and the character of the veins. In spite of this difference in size, I do not think it necessary to separate them in any way from the species just mentioned.

Locality.—All the three specimens are from the Karharbári-beds at Domahni, Karharbári coal-field.

NÖGGERATHIOPS. HISLOPI, var. SUBRHOMBODALIS.

Another leaf is figured on Pl. XX, fig. 2. It agrees in general with the other leaves mentioned as *Nöggerathiops, hislopi*; it is, however, much narrower at base, becoming proportionally wider in the upper part, with an obtusely pointed

apex, so that the shape of the leaf as a whole is more rhomboidal, and I am perhaps not wrong in designating it as var. *subrhomboidatis* of the typical *N. hislopi*. It shows well the oblique shape of the leaf. The veins are also several times distinctly forked.

Locality.—This form is from the Karharbári beds of the Karharbári coal-field, at Jogitand, No. 2 shaft.

I have had already occasion to point out the difference of the leaves known as *Nöggerathia*, from the genus *Schizoneura* and from the Australian form figured as *Zeugophyllites*. There is no necessity to point to this again; but so much I may mention, that Prof. Dana's figures of *Nöggerathia* differ from our forms by the want of forked veins, Dana's figures showing single veins. All the specimens, however, I have seen from New South Wales, from the Newcastle coal-beds, show clearly forked veins. In this they resemble the Indian forms, although the Australian ones partly differ in the shape of the leaf. Still all I have said about the Indian leaves (as differing from *Nöggerathia*) refers also to these Australian leaves from the Newcastle beds; and these, too, in my opinion, cannot be classed with *Nöggerathia*. I would place them with *Nöggerathiopsis* with the respective specific names.

IV.—Class: *CONIFERÆ*?

While it appears to me that the forms just described as *Nöggerathiopsis* (*Nöggerathia*) are more closely related to *Cycadeaceæ* (*Zamiæ*) than to any other class of plant, there is one specimen figured on Pl. XXI which appears to me to be closer allied with some *Coniferæ*. I procured it in January 1877 from the shale of the Buriadi coal mine, in the Karharbári coal-field. It shows a portion of a stem and two leaves lying close to it. Closer examination shows that the upper of the two leaves is attached to the stem, and there is hardly any doubt of its belonging to the same. The attachment or insertion is in such a way that if we imagine the leaf to be detached, there would be left a mark about similar to that shown in the lower portion of the stem nearly in the median line, and I think this mark shows the place where a leaf was inserted.

These circumstances make me believe that the lower of the two leaves also belongs to the stem, although not directly attached to it; but its position, in comparison with that of the upper one, favours this supposition, and it is not impossible that this lower leaf, lying a little to the side of the stem, may be the one detached from the place where the mark is left in the median line of the lower portion of the stem.

The leaves differ in shape from those described in the preceding pages as *Nöggerathiopsis*, although the venation is somewhat similar, but more divergent and slightly arcuate towards the margin; the leaves do not appear, however, so rigid as

¹ United States Exploring Expedition, Geology 1843.

those of the *Nöggerathiopsis*, and recall more the broad leaves of certain *Coniferæ* with which we have probably to compare our fossil. Amongst the living forms of *Coniferæ* to be taken into this consideration, there is especially the genus *Damara*, which has some analogies with our form, but still more perhaps the genus *Phyllocladus*. Amongst the fossil *Coniferæ* a slight analogy is found in the genus *Albertia*. Taking, therefore, the closer relation of our fossil to the *Coniferæ*, as more probable than to any other class of plants, I would propose to consider it as a new genus with the name *Euryphyllum*.¹

In the possible case, that the fossils, already described as *Nöggerathiopsis* in the present paper, should by further investigations (if, for instance, stems or branches should be found) prove to be closer to the *Coniferæ* than to the *Cycadeaceæ*, they would perhaps represent other species of *Euryphyllum*. For the present, however, I treat the former as closer to the *Zamiaæ*.

GENUS: EURYPHYLLUM, nov.

Plantis arboreis; ramis (truncisque?) foliatis; foliis spiraliter dispositis, latis; nervis crebris, e basi radiantibus, pluries furcatis.

Besides the specimen figured, there are also some detached leaves, which, I think, belong to the same genus, but which I have not figured, as they offer no further evidence as to the nature of the plant.

This form is at present known from the Karharbári coal-field only, where the shales of the two lower seams contain the most interesting fossil flora of the Indian coal-bearing rocks.

EURYPHYLLUM WHITTIANUM, sp. n. Pl. XXI, figs. 1, 1a.

Plantis arboreis, foliatis; foliis ovato-spathulatis an rhombico-ovalibus, basi valde attenuatis; apice obtusis; spiraliter dispositis; nervis crebris, e basi crassiusculis, dehinc radiatim folium intrantibus, bis ac pluries furcatis marginem versus subarcuatis.

The only species known at present I name in honour of Mr. I. J. Whitty, the Superintendent of the Karharbári collieries, who was the first to discover this interesting flora.

The figured specimen seems to represent a portion of the stem, and it should perhaps be considered as the upper portion, where leaves are still inserted; two leaves are preserved which can be considered as in connection with the stem; in the median line of the lower portion there is an oblong-oval mark, which, as it appears, is that of a detached leaf.

¹ *Euphr* broad, and *phyllon* leaf.

The leaves, in comparison with their size, appear to have been of a rather soft, or thin, leathery, consistence; they are ovate-spathulate or rhomboidal-ovate, pretty narrow at base. The veins are numerous, thickish, when they pass out from the base, whence they are twice, or several times, forked, radiating into the leaf, slightly arcuate towards the margin. The relations to living forms were mentioned before.

Locality.—Karharbári beds, at Buriadi, No. 11A mine, in the Karharbári coal-field, above the bottom seam.

V.—CLASS: CONIFERÆ.

Our knowledge of fossil *Coniferæ* has been considerably increased by recent investigations. I especially allude to those forms of the mesozoic period which Professor Heer comprises under the name of *Salisburia*; Professor Heer has placed five forms in this family as follows:—

Phœnicopsis, *Baiera*, *Ginkgo* (also written *Gingko*), *Trichopitys*, and *Czekanowskia*.

But this family is also represented in older formations by *Dicranophyllum*, *Brongt.*, and *Gingkophyllum* and *Baiera*. The cretaceous *Eolirion* very likely belongs to the same family. According to the opinion of Professor Heer, the *Nöggerathia* (not the Indian leaves) belong to the *Coniferæ*, or are at least transitional forms, and the form described by me as *Euryphyllum* is most likely also a coniferous plant. These are mostly broad-leaved forms, with numerous veins, and it would seem that this group of *Coniferæ* was much more numerous and more widely distributed in former times than at present, as represented especially by *Damara*, *Phyllocladus*, and *Salisburea*. While I have described the *Euryphyllum* as probably belonging to the *Coniferæ*, I have now to record some true *Coniferæ*.

GENUS: VOLTZIA, *Bgt.*

Arboribus proceris, ramis plus minus regulariter pinnatim ramulosis. Foliis in eadem planta variis, brevioribus et longioribus.

The best existing figures of forms belonging to this genus are in Schimper's and Mougeot's paper: *Monogr. des plantes fossiles du grès bigarré*, and it is in the triassic formation that this genus is most numerous, although it is not absent in permian (see the two species of Professor Heer).

The triassic forms known at present are—

Voltzia heterophylla, Schimp. (include *Voltz. brevifolia*, *V. rigida*, *V. elegans*).

Voltzia acutifolia, Schimp. I think this belongs to the former.

Voltzia recubarensis, Schenk.¹

¹ Schenk: Pflanzenreste des Muschelkalks von Recoaro, in Benecke, *Geol. Pal. Beiträge*, pp. 82-87, tab. VI-XII.

Voltzia pachyphylla, Schimp.¹

Voltzia weismanni, Schimp.,² and *V. coburgensis*, Schaudroth.³

Amongst the plants in the Karharbári beds of the Karharbári field, a coniferous plant was pretty numerous, which I identify as *Voltzia* and as *Voltzia heterophylla*.

VOLTZIA HETEROPHYLLA, Bgt. Pl. XXII; XXIII; XXIV; fig. 4; XXV.

1875. Schimper et Mougeot: Monogr. d. Plantes fossiles du grès bigarré, p. 25, tab. VI—XIV.

Folia dimorphis, his brevioribus, linearis conicis; illis elongatis, linealibus, obtusiusculis, spiraliter dispositis; nervo mediano indistincto.

From the different names which were applied to the different forms of this species, Professor Schimper has retained the name *Voltz. heterophylla*, to indicate the great diversity of the leaves of this plant. I think the same character is exhibited in our specimens. It appears to me, however, that our plant was a little stronger than it is generally the case.

The best specimens are figured on Plate XXV, and fig. 3 bears the appearance of the *V. heterophylla rigida*, Bgt. (see Schimper, l. c., Pl. XIV); fig. 2 represents *V. heterophylla* and *brevifolia*, Bgt.; fig. 1 recalls partly *V. acutifolia* and *rigida*.

On Plate XXIII are also several specimens of *V. heterophylla*; that the leaves are spirally arranged is shown in all the specimens, partly by the position of the leaves, partly by the scars left by the detached leaves, as is represented especially in figs. 1 and 3. Some of Schimper's figures show the same relations, as, for instance, Pl. VI, fig. 1; Pl. X, figs. 1, 2; Pl. XI, fig. 1; Pl. XII, figs. 1, &c.

The longer of the two kinds of leaves appear to have been a little broader in the Indian form, as is especially shown in the specimens, Pl. XXIV, figs. 1, 2; but fig. 4 on Pl. XXIV has the appearance again of *V. heterophylla brevifolia*.

Of stems belonging to *V. heterophylla*, or at least to the plant which I consider to be this species, there are several specimens, which I have figured on Pl. XXII. The larger stems are generally without leaves, but here and there they are preserved—as shown in fig. 3—a portion of the stem with remains of leaves on the right branch, which also exhibits spirally arranged rhomboidal spaces, with cicatriculæ at top where the leaves were inserted.

On the same figure, to the left of the branch just mentioned, is a thinner one (the middle one of the three), which also shows some remains of leaves, besides some oblique longitudinal lines. Similar lines are better shown on the specimens, figs. 4, 5, 6 of the same plate. There are, besides the longitudinal lines, small roundish cicatriculæ, which, so far as can be seen, are arranged in a quincunx; these cicatriculæ are undoubtedly the marks left by detached leaves, and the lines are the sulci separating the leaf areas. Fig. 5 exhibits also longitudinal lines, but they are shorter, and the areas enclosed by the lines are more rhomboidal, and approaching

¹ *Araneites pachyphylla*, Zigno: Pl. foss. d. Trias di Recoaro, p. 22, tab. VII, figs. 1-3.

² Schimper: Pal. végét., II, p. 242.

³ Schenk: Würzburg. Naturwiss. Zeitschr., Vol. VI. tab. I, figs. 4-8.

those of the right branch in fig. 3. For comparison with our fig. 3, Pl. XXII, I have to refer to a paper of Mr. Weiss on *Voltzia* and other plants of the Bunter,¹ where on Pl. V, fig. 1, is a similar portion of a stem.

Figs. 3, 4, 5 (Pl. XXII) are preserved in the same position as they are drawn, on the same specimen of shale; and there is but little doubt that they belong to the same specimen.

Although, I think, I am correct in identifying these coniferous branches with *Voltzia heterophylla*, or at least with *Voltzia*, I shall not at present venture to discuss the possible deductions to be drawn from its occurrence in these beds, together with a single-pinnate *Neuropteris*, and a plant which is an *Albertia*.

Locality.—In the Karharbári beds, of the Karharbári coal-field, at Buriadi, above the bottom seam of No. 11A mine, and at Domahni.

GENUS: ALBERTIA, Schimp., 1844.*

1845. *Haidingera*, Endl.

Together with the different forms of *Voltzia*, there occurs in the "Bunter" of Soultz-les-Bains (Vosges) another coniferous plant, which was described as *Albertia* by Schimper (called *Haidingera* by Endlicher). It is distinguished by broadly obovate-elliptical or oblong-obovate leaves, with an angustate base. Four species are described at present:—

Albertia latifolia, Sch., *Alb. elliptica*, Sch., *Alb. brauni*, and *Alb. speciosa*, Sch. all from Soultz-les-Bains.

With the *Voltzia heterophylla*, in the same shales of the Karharbári coal-measures, there were found two other branchlets, having the appearance of *Albertia* (see Pls. XXIV, fig. 3, and XXVI, fig. 2; also perhaps figs. 1, 2, Pl. XXIV). If we compare our fig. 2, Pl. XXVI, with Professor Schimper's figure of *Alb. speciosa* (i. e., Pl. V) we shall find a great resemblance between the two figures; and it was on this specimen that I based the identification of the Indian *Albertia* with the plant from the Grès Bigarré (*Alb. speciosa*).

Schimper's diagnosis of *Albertia speciosa* is the following:—

Folius elongato ellipticis, tenuissime striatis, patentibus vel patulis, plus minus remotis, basi angustatis, apice obtusiusculis, omnino planis.

This description is well applicable to the specimen figured, Pl. XXVI, fig. 2; and I would have no hesitation to refer it to *Alb. speciosa* were it not for the other specimen on Pl. XXIV, fig. 3, which, I think, belongs to fig. 2, Pl. XXVI, but which differs from Schimper's drawing by the denticulated outer margin.

Considering these circumstances, I think it more advisable to be content with a general identification, and with the indication of the relation of our plant to

¹ Über *Feltzia* und andere Pflanzen des Buntsandsteins zwischen der unteren Saar und dem Rhein; N. J. f. M. Ac., 1864, p. 279 et sequ. Pl. V.

* Schimper et Mougeot. Monogr. d. Pl. foss. d. grès bigarré.

Albertia speciosa, but I abstain from any identification for the present, hoping that some more material will enable us to specify the form.

Locality.—In the Karharbári beds of the Karharbári coal-field, at Buriadi, No. 11A mine.

FOSSIL SEEDS.

CARDIOCARPUM (?) sp. ? Pl. XXIV, fig. 5.

Together with *Foltzia* and *Albertia* some seeds occur, the best of which is figured on Pl. XXIV. From its form it appears to be a *Cardiocarpum*, although this, of course, says nothing as to its systematical position and botanical relations, as it may belong to *Foltzia* or *Albertia*.

Locality.—Buriadi, No. 11A mine, Karharbári coal-field, Karharbári beds.

ANOTHER FOSSIL SEED.

There is another large seed known from Passarabhaia, No. 5D mine, collected last year by Mr. N. Miller. As at that time the plates were already arranged and mostly drawn, I could not give a figure of this interesting specimen, but I shall figure and describe it at a future opportunity. It will be difficult to make out the relations of this seed; but it belongs to some of the known plants: I think it would be in connection with what I have introduced as *Nöggerathiopsis*. I shall describe it as *Carpolithes Milleri*.

GENERAL RESULTS.

The general results of the examination of this flora would be, shortly, the following:—

1. The Talchir shales are especially marked by the genus *Gangamopteris*, there being, besides leaves of this genus, some fragmentary equisetaceous stalks, a *Glossopteris* leaf, and a species of *Nöggerathiopsis* only.

2. The coal strata of the Karharbári coal-field also contain the genus *Gangamopteris* in great number, there being, however, other very characteristic forms.

From this frequent occurrence of *Gangamopteris*, I pointed in my first notes to a close connection of these strata with the Talchirs, extending it, as I thought correctly, to the whole Damuda series, to which the Karharbári coal strata had hitherto been considered to belong. These coal strata in the Karharbári field were, however, subsequently separated from the Damudas (as I explained above) under the name "Karharbári beds," and joined to the Talchirs, which latter name was retained for the combined group.

3. Regarding the age or homotaxis of this flora, it appeared to me that it was possible to judge of it from the presence of some of the other forms, which are related to some forms of the European trias; and as the age of the other plants, such as *Gangamopteris* and *Glossopteris*, appeared to me unsettled, moreover,

Glossopteris having a very wide range, I thought that, on the whole, I could not be wrong in considering these beds as of the lowest triassic age; the more so, as the connection of these lowest beds with the Australian Newcastle-beds did not appear to me to be made out.

These Talchir and Karharbári beds being the lowest of the Gondwána series, it appeared to me also not quite unjustified to attribute their age to the Damuda series, which itself I considered to be in close connection with the Karharbári beds.

4. A comparison of these Talchir-Karharbári beds with one or other group in Australia will show the following peculiarity:—It is known that in Australia the Newcastle beds (upper coal-measures) are characterized by the frequent occurrence of *Phyllothea*, *Vertebraria*, and specially *Glossopteris*; of *Gangamopteris* there are two species (one in one leaf only); *Nöggerathia* (*Nöggerathiopsis*?) is rarer than in the Damudas.¹

Compare this with the Talchir-Karharbári beds: in the Talchir shales, no *Phyllothea*, no *Vertebraria*, *Gangamopteris* prevailing, and one leaf of *Nöggerathiopsis*; in the Karharbári beds, no *Phyllothea*, *Vertebraria* very rare, *Gangamopteris* very numerous, *Glossopteris* rarer in specimens and forms; but besides this, add single-pinnate *Neuropteris*, very frequent, *Foltzia*, numerous, *Albertia* and others, of which nothing is found in any Australian strata. The direct connection of our Talchir-Karharbári beds with the Newcastle beds is therefore not quite so apparent.

We have now to examine if there is in Australia perhaps another formation which could be better compared with these Talchir-Karharbári beds, or at least as well as the Newcastle beds. In Victoria there is a series of beds, called Bacchus-Marsh sandstone, which contains no other fossils but *Gangamopteris*; there are three species described, of which *Gangamopteris obliqua* is the most common, and *Gang. spathulata* rare, while *G. angustifolia* is frequent; all these are represented in the Talchir-Karharbári beds, where *Gangamopteris* also is the characteristic fossil, by certain forms, i. e., *Gang. obliqua* by *Gang. cyclopteroides*, *Gang. spathulata* by *Gang. major*, and *Gang. angustifolia* by the same form.

It seems, therefore, that the most natural term of comparison for our Talchir-Karharbári beds would be the Bacchus-Marsh sandstones; the age of these strata, however, is not quite clear; but so much appears certain, that they are not older than the Newcastle beds (upper coal-measures), of which they may partly be the representatives. In the Prodrôme of Palæontology (Dec. II) Prof. McCoy speaks of the Bacchus-Marsh sandstones as mesozoic, and in the Reports of Progress by Mr. R. Brough Smyth they are put down as "lower mesozoic" (I. Rep., 1874, p. 34), and as "middle carbonaceous," above the *Glossopteris*-beds (Rep. VI, 1876, p. 60). The Rev. W. B. Clarke also seems not to be opposed to their mesozoic age.²

¹ I must specially point out that *Alethopteris australis* was not found in the Newcastle beds.

Of *Gangamopteris*, the *G. angustifolia* only was hitherto known; lately I recognised another species amongst the specimens from Bowenfels (sent by Mr. W. B. Clarke) which I describe as *G. clarkiana* (only one leaf—rare).

² Mines and Minerals, 1875, pp. 181, 185 & 186.

In a letter, dated 12th September 1877, to the Rev. W. B. Clarke, which this latter gentleman had the kindness to send me for inspection, Mr. Wilkinson, the Australian geologist, himself suggests an analogy of the Bacchus-Marsh sandstones with the Talchirs, etc., writing thus: "It is not improbable that the latter (Bacchus-Marsh sandstones) form the base of a great series of which the carbonaceous shales (in Victoria, the upper beds) are the upper members, similar to the Rájmahál and Talchir-groups of the Gondwána series; but their actual connection has not yet been ascertained." And recently the same author wrote to me in the same sense.

If we assume, as an extreme probability, that the Bacchus-Marsh sandstones are representatives of the Newcastle beds, and both, therefore, the nearest representatives of the Talchir-Karharbári horizon, it would appear to me that the peculiar plant forms (*Phyllothea*, *Vertebraria* and *Glossopteris*) of the Damuda flora (as on a higher horizon) might be considered as a repetition, or reappearance, of these forms of the "Newcastle beds flora"; just as in the case of the floras of the lower and upper coal beds in Australia, of the upper Gondwána flora in Kach and in the Rájmahál group, of *Phyllothea* in Australia, Italy, and Siberia, and of *Glossopteris* in the lower and upper Gondwánas in India.

I shall not enter at present on a closer discussion of the subject, only adding here, for easier comprehension, three lists, containing in four columns the floras of the Lower Trias, of the Talchir-Karharbári beds, of the *Gangamopteris* beds (Bacchus-Marsh sandstone) in Victoria, and of the Newcastle beds in New South Wales; which will show, (1) the specific identities between these named floras, (2) the generical identities, and (3), in a full list of the floras of these beds, the related forms marked in each of the columns. I do not take the list of pernian plants into consideration, as there would be only *one generical* relation with the Talchir-Karharbári and the Australian coal-beds; and on such grounds I should have to compare also the upper Gondwánas and other mesozoic beds, in which there would appear more forms generically related; but this would make the comparison unnecessarily complicated.

I do not now take into consideration the Damuda fossils, for which a similar list will be given with the description of that flora—

List I.—Specific identities.

Bunter.	Talchir-Karharbári beds.	Bacchus-Marsh sandstones, Victoria.	Newcastle beds, N. S. Wales.
1.—EQUISETACEÆ.	1.—EQUISETACEÆ.	1.—EQUISETACEÆ.	1.—EQUISETACEÆ.
2.—FILICES.	2.—FILICES. <i>Gangamopteris angustifolia</i> McCoy. (Very rare.)	2.—FILICES. <i>Gangamopteris angustifolia</i> , McCoy. (Frequent.)	2.—FILICES. <i>Gangamopteris angustifolia</i> , McCoy. (Seen common in the grey shale near Gunlawang Mudger, N. S. Wales.)
3.—CYCADACEÆ.	3.—CYCADACEÆ.	3.—CYCADACEÆ.	3.—CYCADACEÆ.
4.—CONIFERÆ. <i>Foltzia heterophylla</i> , Bgt. (Frequent.)	4.—CONIFERÆ. <i>Foltzia heterophylla</i> , Bgt. (Pretty frequent.)	4.—CONIFERÆ.	4.—CONIFERÆ.

List II.—Generical identities.

In this list only those genera of the Talchir-Karharbári flora are given which are also represented in one or the other of the compared floras—

Buster.	Talchir-Karharbári beds.	Baccharis-Murch mandstone, Victoria.	Newcastle beds, N. S. Wales.
1.—EQUISETACEÆ. <i>Genus: Schizoneura.</i>	1.—EQUISETACEÆ. <i>Genus: Schizoneura.</i> (Rare.) <i>Genus: Vertebraria.</i> (Rare.)	1.—EQUISETACEÆ.	1.—EQUISETACEÆ. <i>Genus: Vertebraria.</i> (Frequent.)
2.—FILICES. <i>Genus: Neuropteris.</i> Single-pinnate forms (<i>Neuropteridium</i>).	2.—FILICES. <i>Genus: Neuropteris.</i> Single-pinnate forms (<i>Neuropteridium</i>). (Frequent.) <i>Genus: Gangamopteris.</i> (Very numerous.) <i>Genus: Glossopteris.</i> (Rather rare.)	2.—FILICES. <i>Genus: Gangamopteris.</i> (Very numerous.)	2.—FILICES. <i>Genus: Gangamopteris.</i> (Rare.) <i>Genus: Glossopteris.</i> (Very numerous.)
3.—CYCADACEÆ.	3.—CYCADACEÆ (?) (<i>Nöggerathiopteris</i>).	3.—CYCADACEÆ.	3.—CYCADACEÆ (?) (<i>Nöggerathiopteris</i>).
4.—CONIFERÆ. <i>Genus: Voltzia.</i> <i>Genus: Albertia.</i>	4.—CONIFERÆ. <i>Genus: Voltzia.</i> <i>Genus: Albertia.</i>	4.—CONIFERÆ.	4.—CONIFERÆ. <i>Genus: Nöggerathiopteris</i> (?)

List III.—Analogous forms.

In this list the columns show the full number, as far known at present, of the fossils from the several groups, and the analogous forms are placed opposite each other in each column.

Buster.	Talchir-Karharbári beds.	Baccharis-Murch mandstone, Victoria.	Newcastle beds, N. S. Wales.
.....	.....	.....	ANIMALS. Fishes. <i>Urosteus australis</i> , Dana.
PLANTS.	PLANTS.	PLANTS.	PLANTS.
I.—Equisetaceæ. <i>Genus: Schizoneura.</i> <i>Schizoneura paradoxa</i> , Sch. et M. <i>Genus: Equisetum.</i> <i>Equisetum mongeoti</i> , Brt. <i>Equis. brongniartii</i> , Schimp.	I.—Equisetaceæ. <i>Genus: Schizoneura.</i> <i>Schizoneura? meriani</i> , Sch. (Karharbári). <i>Genus: Vertebraria.</i> <i>Vertebraria indica</i> , Bunb. (Karharbári. Rare.)	I.—Equisetaceæ.	I.—Equisetaceæ. <i>Genus: Vertebraria.</i> <i>Vertebraria australis</i> , McCoy. (Frequent.) <i>Genus: Phyllothesa.</i> <i>Phyllothesa australis</i> , McCoy. (Frequent.)
II.—Filices.	II.—Filices.	II.—Filices.	II.—Filices.
<i>Genus: Neuropteris</i> —single-pinnate (<i>Neuropteridium</i>).	<i>Genus: Neuropteris</i> —single-pinnate (<i>Neuropteridium</i>).	.....	.....

Buxton.	Talchir-Karharbari beds.	Buchan March sandstones, Victoria.	Newcastle beds, N. S. Wales.
---	<i>Sagenopteris (?) stoliczkanus</i> , Fetz.	---	---
III.—Cycadeaceae.	III.—Cycadeaceae.	III.—Cycadeaceae.	III.—Cycadeaceae.
	Genus: <i>Glossosamites</i> .	---	---
	<i>Glossos. stoliczkanus</i> , Fetz.	.....	Genus: <i>Zugophyllites</i> , <i>Zugophyll. elongatus</i> , Morr.
	a.— <i>Nöggerathiopsidea</i>.	.....	a.— <i>Nöggerathiopsidea (?)</i>
	Genus: <i>Nöggerathiopsis</i> . <i>Nögg. hialopi</i> , Bunb. (Karharbari Talchir). <i>Nögg. hialopi</i> , var. <i>rubrhoromboidalis</i> (Karharbari).	---	Genus: <i>Nöggerathiopsis (?)</i> <i>Nögg. spathulata</i> , Dan.
		---	<i>Nögg. elongata</i> , Dan.
Genus: <i>Pterophyllum</i> . <i>Pterophyllum hogardi</i> , Sch. et M. Genus: <i>Zamites (?)</i> <i>Zamites (?) vogesiacus</i> , Sch. et M.	IV.— <i>Coniferae</i> ? Genus: <i>Euryphyllum</i> . <i>Euryphyllum whitianum</i> , Fetz.		
V.— <i>Coniferae</i> .	V.— <i>Coniferae</i> .	V.— <i>Coniferae</i> .	V.— <i>Coniferae</i> .
Genus: <i>Foltzia</i> . <i>Foltzia heterophylla</i> and <i>acutifolia</i> , Bgt.	Genus: <i>Foltzia</i> . <i>Foltzia heterophylla</i> . (<i>Foltz. acutifolia</i>), Bgt. (Karharbari).	---	---
Genus: <i>Albertia</i> . <i>Albertia speciosa</i> , Schimp. <i>Alb. latifolia</i> , Schimp. " <i>browni</i> , Schimp. " <i>elliptica</i> , Schimp. " <i>schaurothiana</i> , Mass. Genus: <i>Taxites</i> ? <i>Tax. massonlongi</i> , Zigno. " <i>viculinus</i> , Zigno.	Genus: <i>Albertia</i> . <i>Albertia</i> , sp. ..... ..... ..... ..... ..... ..... ..... ..... .....	..... ..... ..... ..... ..... ..... ..... ..... .....	..... ..... ..... ..... ..... ..... ..... ..... .....
Monocotyledones.			
<i>Liliaceae</i> . <i>Yuccites vogesiacus</i> , Sch. et M.	..... .....	..... .....	..... .....
GENERA OF DOUBTFUL POSITION. ¹			
<i>Spirangium regulare</i> , Sch. <i>Actinophyllum speciosum</i> , Sch. et M. " <i>stipulare</i> , Bgt. " <i>fösterleianum</i> , Mass.	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....

¹ Amongst the specimens sent by Rev. J. W. B. Clarke, 1878.² Schimper in Vol. III, *Pal. végét.*, p. 646, writes distinctly: "Genre dont la place est indéterminée."

REMARKS ON THE DISTRIBUTION OF THE FOSSIL PLANTS IN THE KARHARBARI COAL-FIELD.¹

I have mentioned before that the coal-strata of the Karharbári coal-field have been recently distinguished as "Karharbári beds," and separated from the Damuda series. As there are, however, four principal coal-seams known to occur, three of which yielded fossil plants, it will, I think, be of some interest to investigate from the fossil plants, and from their distribution at the several localities in the different seams, which strata in the Karharbári coal-field are specially to be distinguished as "Karharbári beds," and if there are not representatives of other strata. The information on this point I have collected partly myself, when in the field in 1877, but especially through the kindness of Mr. I. J. Whitty, and later of Mr. N. Miller. The published report on the Karharbári coal-field² is devoted to the stratigraphical and economical relations only. My object, however, is now to show from what localities fossil plants have been made known, and to what seams at these localities the plants belong.

The collections hitherto made have been from the south-eastern portion of the field near Serampur, from the northern and north-western portion round Karharbári, and from one locality on the southern boundary of the field, at Domahni Ghát, near the junction of the Khakoo and Sooknid streams, while from the western portion no fossils are known at present.

It will be, I think, best to discuss the localities according to these positions, including Domahni in the south-eastern portion, while the Lumki (Komaljore) Hill, as well as the Bhuddua Hill will be considered separately.

I.—LOCALITIES IN THE SOUTH-EASTERN PORTION NEAR SERAMPUR.

(District of lowest seams, 1 and 2).

In this portion, so far as known at present, two seams (the lowest) only occur, corresponding to the two lowest seams in the northern and north-western portion.

1. *Shaft No. 11A near Buriadi.*—The chief place of mining, whence also most of the fossils were procured, is Buriadi, close to the eastern boundary of the field; and it is in the shale above the bottom seam of Shaft No. 11A that the fossils were found. From this shaft were taken the two big slabs of shale with impressions of fossil plants which were presented by Mr. I. J. Whitty to the Geological Museum. The following section (in descending order) of this shaft shows the position of the fossiliferous band; I am indebted for it to Mr. Whitty:—

Shaft No. 11A, (Buriadi).

Soil and brick-work	...	...	...	10' 0"
Sandstone	...	...	...	64' 11"
Coal	...	...	...	2' 0"
Sandstone	...	...	...	43' 0"
Coal	...	...	...	2' 6"
Sandstone and shale	...	...	...	3' 3"
				Fossil plants found here, in the roof of the bottom seam.
Coal (bottom seam)	...	...	...	14' 0"
				Total
				121' 2"

¹ The new numbers of the shafts will be found at end, in an appendix.

² Hughes: Mem. Geol. Surv. India, 1871, Vol. VII.

The plants were procured from the shales of the 3' 3" band, above the 14' seam; they are preserved in a dark-grey, fine-grained and slightly micaceous shale. They are very fairly preserved, and in most of the cases covered with a thin film of coal. This is the richest locality in plants. The following species and varieties were determined:—

Neuropteris valida, Fstm. Frequent.
Gangamopteris cyclopteroides, Fstm. Frequent.
Gang. cyclopteroides, var. *auriculata*.
Gang. cyclopteroides, var. *arcolata*.
Gang. cyclopteroides, var. *attenuata*.
Gang. buriadica, Fstm.
Gang. major, Fstm.
Glossopteris decipiens, Fstm.
Nüggerathiopsis histopi, Bunb. sp.
Euryphyllum schittianum, Fstm.
Foltzia heterophylla, Bgt.
Albertia.

2. *Mines near Chunka (Chunika)*.—I have to notice three shafts from near Chunka, i. e., No. 16, No. 16G, and No. 16A, of which the two former only have yielded some fossil plants, but although only few, these show that they are of the same character as the flora from Buriadi.

a.—*Shaft No. 16, (Chunka)*.

From here Mr. Whitty sent, on the 15th of May 1877, some fossils, with the following remark: "I send you a few fossils from roof of the seam at Chunka (No. 16), Serampur, near our southern boundary, which I consider to be the same as I am working at No. 11A mine, Buriadi, which lies immediately over the Talchirs." This view is, I think, supported by the fossils. The shale from this shaft is exactly like that of No. 11A mine, and is also as full of leaves. There were, however, two species only—

Gangamopteris cyclopteroides, Feistm. Frequent.
Gangamopteris major, Feistm.

The shaft No. 16 lies close to Chunks, and the section is the following:—

Soil and brick-work	...	...	...	18'	6"
Sandstone	...	...	...	16'	6"
Coal	...	...	...	7'	6"
Sandstone and shale	...	...	...	12'	6"
Fossil plants found here in the roof of the seam.					
Coal	...	...	...	9'	0"
Not cut through.					

b.—*Shaft No. 16G, (Chunka)*.

On the 16th of July 1877, Mr. Whitty sent some other specimens of shale with plant impressions from the shaft No. 16 G near Chunka to the north-west of the shaft No. 16, with the following remark: "The fossils I now send were found

in the roof of the lower seam in No. 16 G, which is the same seam as I am working at No. 16 shaft." The fossils represented only one species, *Gangamopteris major*, Fstm.

	Soil and brick-work	—	—	—	11' 3"
	Sandstone	—	—	—	4' 1"
	Black slaty stone	—	—	—	4' 3"
	Sandstone	—	—	—	25' 5"
	Coal	—	—	—	6' 0"
	Sandstone (very hard) and shale	—	—	—	6' 6"
					Fossils found here immediately overlying the coal.
(Lower seam) —	Coal	—	—	—	12' 6"
	Black shale	—	—	—	7' 6"
					with indistinct plant impressions.
	Sandstone	—	—	—	1' 6"
	Total				115' 0"

The plant impressions here are in a more sandy shale, recalling that of Passarabha. One of the specimens from this fossiliferous band above the coal had still a piece of sandstone attached, in which I could observe with the lens several grains of *garuets*; I mention this because it does not seem to me very common in the Indian coal-measures, and because the sandstone near Passarabha and Jogitand, in the same position above the seam, shows the same character.

c.—Shaft No. 16A, (Chunka).

This shaft lies about 850 feet east of 16G, but it was not yet cut through last year, so that no fossils could be observed.

The section was then the following:—

Soil and brick-work	—	—	—	23' 0"
Sandstone	—	—	—	26' 0"
Coal	—	—	—	0' 6"
Sandstone	—	—	—	16' 0"

In this shaft also Mr. Whitty expected to find the same seam as at 11 A, Buriadi. The seams at all the three shafts near Chunka and the plant remains have to be considered identical with those at Buriadi, No. 11 A shaft.

3. *Locality—Domahni Ghât.*—This locality lies about 3 miles to the west-north-west of Chunka, and the description of it should, by position, come after that of the Komaljore (Lumki) hill, but as the seam in the latter place is much newer than those at Buriadi and Chunka, I first take Domahni into consideration, the seam here being the same as in those localities. The Komaljore hill will be discussed at the end, with the Bhuddua hill, both containing the highest (4th seam.)

Domahni Ghât is at the junction of the Khakoo and Sooknid rivers, and a section of a shaft (No. 14) was given by Mr. Hughes (*l. c.*, p. 26). I did not see the locality myself, and the fossils from here were already amongst the collections

of the Survey since 1871. The shale in appearance is the same as that of Buriadi, and the fossils too agree. I could determine the following:—

- Neuropteris valida*, Fstm. Top portion.
Gangamopteris major, Fstm.
Gangamopteris comp. *angustifolia*, McCoy. Preserved with this determination in the Survey collection.
Sagenopteris (?) *stoliczkaana*, Fstm.
Nägerathiopsis hislopi, Bunb. sp.
Glossosamites stoliczkaana, Fstm.
Peltzia heterophylla, Bgt.

II.—LOCALITIES IN THE NORTHERN AREA, ROUND KARHARBARI.

In this ground we shall have to consider three seams, Nos. 1, 2, 3; at the localities Passarabha (all three seams), and at Máthadi and Jogitand (two lower seams); while the 4th seam is known on the Bhuddua hill, which I shall discuss together with the locality on the Komaljore (Lumki) hill.

1. *Localities in the bottom seam near Passarabha east of Karharbári.*—The mines near Passarabha are the most important in the field, and a branch railway leads to the place from Giridi, as well as to Buriadi.

a.—Shaft No. 5D, (Passarabha).

When in the field (1877) I visited the shaft No. 5D, from which previously two fine specimens were sent down by Mr. Whitty; they contained large leaves of *Glossopteris communis*, Fstm.; some fossils were already in the Survey collections, and some others were collected by myself. The section of the shaft is the following:—

	Soil and brick-work	—	—	—	21' 6"
	Sandstone	—	—	—	1' 0"
	Coal	...	—	—	0' 11"
	Sandstone	—	—	—	4' 7"
	Shale, with threads of coal	—	—	—	1' 10"
	Sandstone	—	—	—	1' 0"
	Shale, with thin seam of coal	—	—	...	2' 7"
	Sandstone, with threads of coal	—	—	—	8' 1"
(2nd seam)	Coal	—	—	—	7' 2"
	Laminated carbonaceous sandstone and shale	—	—	—	2' 6"
	Fossils found here in the roof of the lower (1st) seam.				
(1st seam)	Coal	—	—	—	5' 6"
	Sandstone	...	—	—	2' 0"
	Coal	—	—	—	1' 2"
	Sandstone	—	—	—	1' 0"
	Coal	...	—	...	2' 0"
	Black shale	—	—	—	2' 2"
	Total				65' 0"

The fossiliferous band thus occurs here in about the same position as at the previous localities. The fossils determined from here are—

Schizoneura comp. *meriani*, Schimp. Fragments.

Other *equisetaceous* stalks.

Fertelbaria indica, Royle. Rare and fragmentary.

Glossopteris communis, Fstm. Several specimens.

Gangamopteris cyclopteroides, Fstm.

Neuropteris valida, Fstm. Small specimen.

Nöggerathiopsis hislopi, Bunb. sp. Pretty frequent.

Fossil seed, large, sent by Mr. N. Miller. (Belonging perhaps to *Nöggerathiopsis*).

b.—Shaft No. 5G, (Passarabhia).

This shaft was not visited by myself; but fossil plants were collected by Mr. N. Miller and sent to me for determination together with the section of the shaft—

	Brick-work, sandstone, &c.	—	—	18'	16"
	White sandstone, with two thin layers of coal	—	—	62'	6"
	Coal	—	—	0'	11"
	White sandstone	—	—	18'	0"
Seam No. 2	Coal, with bands of stone	—	—	7'	0"
	Micaceous dark sandstone with shale	—	—	2'	6"
				The fossils found in this band above the bottom seam.	
Seam No. 1	Coal	—	—	5'	6"
	Sandstone	—	—	2'	0"
	Coal	—	—	1'	2"
	Sandstone	—	—	1'	0"
	Coal	—	—	2'	0"
	Dark shale	—	—	6'	11"
Total				128'	0"

The fossils determined are—

Neuropteris valida, Fstm., more frequent than at 5D, completely of the same forms as at No. 11A, Buriadi.

Gangamopteris cyclopteroides, Fstm.

Glossopteris communis, Fstm. Here associated (as at No. 5D) with *Neuropteris valida*.

Nöggerathiopsis hislopi, Bunb. sp.

The fossil plants show, therefore, that the horizons at No. 5D and 5G are identical, and also, as will be further shown, the same as those of Máthadi and Jogitand, and all with those at Buriadi, Chunka, and Domahni. The sandstone above the seam is highly garnetiferous.

The 2nd seam in both shafts did not furnish any fossils.

2. *Localities near Passarabhia (3rd seam area).*—Mr. N. Miller sent also some fossils from two other shafts (17B and 17C) near Passarabhia, which are the more

interesting, as they come from a seam, which in the field is considered as the 3rd seam, 161 feet over the seams (1 and 2) of the shafts No. 5D and No. 5G (see Appendix); in the shaft No. 17C, the fossils occur in the roof of this 3rd seam, and in the shaft No. 17B within the seam, close to the roof.

a.—Shaft No. 17C, (Passarabha).

	Soil	...	...	...	1'	6"
	White sandstone	...	...	...	29'	0"
	Coal	...	...	...	0'	9"
	White sandstone	...	...	...	43'	9"
	Dark shale	...	...	...	6'	0"
	Fossils from this band of shale above the 3rd seam.					
No. 3 seam	Coal	...	...	...	4'	0"
	Stone	...	...	...	0'	3"
	Coal	...	—	...	3'	3"
	Dark shale	...	...	...	0'	3"
Total					87'	9"

The fossils which I could determine were the following:—

Gangamopteris cyclopteroides, Fstm. Several specimens.

Gangam. cyclopter. var. *attenuata*. Frequent.

Glossopteris communis, Fstm. Frequent.

Glossopteris—another species with more horizontal, oblong and distinct meshes; this is not known at present from the bottom seam, but is a form frequent enough in the Damuda sub-division.

Nöggerathopsis hislopi, Bunb. sp.

We have to notice, as regards these fossils, the absence of *Neuropteris valida* and other forms, and the rather frequent occurrence of *Glossopteris*, but still together with *Gangamopteris*. I mark this specially, because, when further on, speaking of the Mohpáni fossils, I shall have opportunity to point to this.

b.—Shaft No. 17 B, (Passarabha).

The fossiliferous band in this shaft was found within the 3rd seam, as is shown from the following section:—

	Brick-work	...	...	...	15'	3"
	Sandstone	...	...	...	4'	9"
	Soft coal	...	...	...	3'	0"
	Sandstone	...	...	...	91'	6"
Seam No. 3	Coal	...	...	...	2'	0"
	Stone	...	...	...	0'	6"
	Coal —	...	...	...	2'	0"
	Stone (shale, etc.)	...	...	...	1'	0"
	Fossils were found in this band of shale.					
	Coal	...	...	...	0'	6"
	Stone	...	...	...	0'	9"
	Coal	...	...	...	1'	6"

I determined the following fossils :—

Gangamopteris cyclopteroides, Fstm. Numerous.

Gangam. cyclopteroides, var. *attenuata*. Several leaves.

Glossopteris communis, Fstm. Numerous.

Niggarathiopsis kialopi, Bunb. sp. Very large leaves, with very distinctly dichotomous veins.

The other species of *Glossopteris* was not found at this place, but still *Glossopteris communis* is more frequent than at the localities mentioned before; so that I have no hesitation to consider the fossils of the shafts 17 B and 17 C as of the same horizon. The great number of *Glossopteris* distinguishes the flora of the 3rd seam (at 17 B and 17 C) somewhat from that of the lower seams; but, on the other hand, the great number of *Gangamopteris* brings it much closer to these than to the 4th seam, as I shall show further on.

3. *Locality—Máthadi, south-west of Passarabha.*—At Máthadi, south-west of Passarabha, I collected, together with Mr. N. Miller, fossils from No. 1 shaft. This shaft works the lowest seam, and the position of the fossiliferous band is the same as at Passarabha and the other places mentioned before. The section is the following :—

Shaft No. 1, (Máthadi).

Soil and soft sandstone	...	...	21' 0"	
Sandstone	...	...	19' 2"	
Coal	...	...	0' 3"	
Conglomerate	...	...	7' 7"	
Coal	...	...	0' 2"	
Sandstone, with bands of dark shale	...	...	6' 7"	The fossils were found here above the bottom seam.
Coal (bottom seam)	...	...	13' 0"	
		Total	67' 4"	

The fossils are preserved in a dark, fine-grained shale, are abundant as regards numbers, but represent two species only—

Gangamopteris cyclopteroides, Fstm.

Glossopteris communis, Fstm.

4. *Locality—Jogitand.*—To the north-west of Jogitand close to the Durdurwa river, fossils were obtained from shaft No. 2, again from the roof of the lowest (bottom) seam.

The section is the following :—

Shaft No. 2, (Jogitand).

Soil and brick-work	...	...	29' 0"	
Sandstone	...	...	17' 0"	
Coal	...	...	2' 6"	
Black shale	...	...	2' 6"	The fossils were found here above the bottom seam.
Coal	...	...	8' 0"	

The fossils I could determine are—

Glossopteris decipiens, Fstm. A small specimen of the same species as at Buriadi.

Gangamopteris cyclopteroides, Fstm., and var. *attenuata*.

Näggerathiopsis hislopi, Bunb. sp.

" " var. *austrorhomboidalis*.

It remains now to discuss the flora of the highest seam.

III. THE SEAMS ON THE BHUDDUA AND KOMALJORE HILLS, 4TH SEAM,

While the three lower seams are worked near Passarabha, the highest or 4th seam is worked to the south of Passarabha on the Bhuddua hill. From here no fossils are known to me at present, but there is another locality to the east of the Bhuddua hill, i. e., on the Komaljore or Lumki hill, where some shales above the 4th seam were found to be fossiliferous. Amongst the specimens previously in the collection of the Survey, I found two with the label: "Komaljore hill, Kurhurbali coal-field, shale altered by trap." It is a sandy, burnt shale, and contains impressions of a *Schizoneura*.

When I visited the coal-field in 1877, Mr. N. Miller accompanied me to the Lumki hill and shewed me the spot where similar pieces of shale and blocks of sandstone, burnt and altered on the surface, were lying about; this was in the northern portion of the Lumki hill. From the shales I collected similar impressions to those which were in our Museum. Subsequently, Mr. Miller found similar indications on the southern side of the hill, and he could also trace a section which showed that these shales and sandstones are the residue from a burnt seam. The section was the following in descending order:—

4. Burnt sandstone.
3. Shale and sandstone intermixed, as slag.
2. Yellowish-reddish burnt shale.
1. Ashes—remainder of seam.

There is no doubt that the shale mentioned before, in the northern portion of the hill, where the fossils were procured, is the burnt shale above the seam. Mr. Miller afterwards sent some more fossils, amongst which I could determine the following:—

Schizoneura gondwanensis, Fstm.: three distinct specimens.

Vertebraria indica, Royle. Fragments.

Glossopteris communis, Fstm.

Gangamopteris. Fragment, indistinct.

Sphenopteris polymorpha, Fstm. This is of importance.

Mr. Ball subsequently obtained at the same locality a large specimen containing this *Sphenopteris polymorpha*.

Mr. Miller considers this burnt seam to be the representative of a small seam close above the "Bhuddua seam," this being the highest, the 4th, in the field, as is indicated also by the fossils (especially by *Sphenopteris polymorpha*); it lies about 200' higher than the 3rd seam at Passarabha.

We have therefore the following horizons and floras in the Karharbári coal-field (in descending order), to which may be added the Talchir group:—

Horizon (seam).	Location.	Flora.
Highest (4th) seam ...	Bhodua hill ... Barat seam of Lumki hill ...	<i>Schizoneura gondwanensis</i> , <i>Vertebraria indica</i> , <i>Glossopteris communis</i> , <i>Gangamopteris</i> , <i>Sphenopteris polymorpha</i> .
The 3rd seam ...	Passarabhis, No. 17B & No. 17C	<i>Gangamopteris cyclopteroides</i> and var. <i>attenuata</i> , <i>Glossopteris communis</i> , <i>Glossopteris</i> —another species, with wider lobes (<i>Gl. damudica</i>), <i>Neggerathiopsis hislopi</i> .
The 2nd seam ...	Passarabhis, etc. ...	No flora known at present.
The 1st seam (bottom seam).	Passarabhis, Máthadi, Jogitand, Buriadi, Chunks, Dabmahi.	<i>Schizoneura</i> , comp. <i>Meriani</i> , <i>Vertebraria</i> , <i>Neuropteris valida</i> , <i>Gangamopteris cyclopteroides</i> and varieties, <i>Gang. buriadica</i> , <i>Gang. major</i> , <i>Gang. angustifolia</i> , <i>Glossopteris communis</i> , <i>Gl. decipiens</i> , <i>Sagenopteris atoleucaua</i> , <i>Glossosmites atoleucaua</i> , <i>Neggerathiopsis hislopi</i> , and var., <i>Eryphyllum whittianum</i> , <i>Volzia heterophylla</i> , <i>Albertia</i> .
Talchir group (shale) ...	Deoghar field (Karon), Kárapura coal-field.	<i>Equisetaceae</i> stalk, <i>Gangamopteris cyclopteroides</i> and varieties (predominant form), <i>Gangamopt. angustifolia</i> , <i>Glossopteris</i> , <i>Neggerathiopsis hislopi</i> .

If we now examine the foregoing list, we may draw the following conclusions:—

1. The Talchir flora is completely contained in the flora of the bottom seam of the Karharbári coal-measures; and it is quite apparent that these two floras belong to the same sequence of deposits; and it is specially the bottom seam in the Karharbári field which is the representative of the "Karharbári beds," which, together with the Talchir shales, forms the "Talchir sub-division" of the new classification.

2. The 2nd seam has not yielded any flora up to date.

3. The flora of the third seam is, indeed, marked by a greater occurrence of *Glossopteris*; but in the same time *Gangamopteris* is very frequent, and there being no other distinguishing feature, I think that there is no objection to consider also this seam as belonging to the Karharbári beds, or to the Talchir division (see Mohpáni).

4. As regards now the 4th seam, it appears to represent another horizon. *Gangamopteris* is only rare, but, on the other hand, *Schizoneura gondwanensis* is present, *Glossopteris* is present, *Vertebraria* also, and then especially remarkable is the presence of the *Sphenopteris polymorpha*, which was first made known from the Barákars of the Talchir coal-field, and then was discovered also in the Rániganj group in the Rániganj coal-field. As the three lower seams have to be considered as "Karharbári beds," it appears to me that the 4th seam represents the Damuda division and apparently the Barákar group, considering this as the lowest, and it would therefore appear true that *Schizoneura* also is in the Barákars (as I before maintained), and that the flora in the Damuda division is in general equable throughout.

List showing the distribution of fossils in the Karharbâri coal-field (including the Talchir fossils) according to the horizons and localities.

FOSSILS.	TALCHIR SUB-DIVISION.											REMARKS.	
	KARHARBÂRI BEDS.												
	1st (bottom) seam.							2nd seam.		3rd seam.			4th seam.
	Chunkei.		Pamunabâli.			Pamunabâli.		Pamunabâli.		Lundi (Kongari) Hill.			Bladina Hill.
	11 A shaft, Bortoli.	No. 16.	No. 16B.	Dumaili.	No. 16D.	No. 1 shaft, Matind.	No. 2 shaft, Jagtand.	No. 17B.	No. 17C.	Lundi (Kongari) Hill.	Bladina Hill.		
	Talchir shales.												
I.—EQUISETACEÆ.													
<i>Schizoneura gondwanensis</i> , Fstm.	...	...	...	...	...	...	...	...	...	+	...	The same species in the Damudas elsewhere, in the Panchet group. The genus in the European Trias.	
<i>Schizoneura</i> , sp.	...	+	...	...	...	...	...	...	...	...	...		
<i>Schizoneura</i> comp. <i>Meriani</i> , Schimp.	...	...	...	...	+	...	...	...	...	...	...	Trias in Europe.	
<i>Equisetaceus</i> stalk	...	...	...	...	+	...	...	...	...	...	...	Undeterminable.	
<i>Vertebraria indica</i> , Royle	...	...	...	...	+	...	...	...	...	+	...	The same species in the Damudas elsewhere. The genus in the Newcastle beds, New South Wales.	
II.—FILICES.													
<i>Sphenopteris polymorpha</i> , Fstm.	...	...	...	...	...	...	...	...	...	+	...	In the Damudas.	
<i>Neuropteris</i> (<i>Neuropteridium</i>) <i>valida</i> , Fstm.	...	+	...	+	+	...	...	...	...	...	...	Single pinnate forms of the European Trias.	
<i>Gangamopteris cyclopteroides</i> , Fstm.	...	+	+	...	+	+	+	+	+	+	...	Genus in the Newcastle beds and in the Bacheus-Marsh sandstone, Victoria, <i>Gangam. obliqua</i> from the latter, the analogous form.	
<i>Gangam. cyclopteroides</i> , var. <i>subauriculata</i>	...	+	...	...	...	...	...	...	...	...	...		
<i>Gang. cyclopteroides</i> , var. <i>areolata</i>	...	+	...	...	...	...	...	...	...	...	...		
<i>Gangam. cyclopteroides</i> , var. <i>attenuata</i>	...	+	...	...	...	...	...	...	+	+	...		
<i>Gangam. bariadica</i> , Fstm.	...	...	...	...	...	...	...	...	...	...	...		
<i>Gangam. major</i> , Fstm.	...	...	+	+	+	...	...	...	...	...	...	<i>Gangam. spatulata</i> , an analogous form in Victoria, (Bacheus-Marsh sandstone).	
<i>Gangam. angustifolia</i> , McCoy	...	+	...	...	+	...	...	...	...	...	...	The same form in Victoria (Bacheus-Marsh sandstone) and in the Newcastle beds, New South Wales.	

FOSSILS.	TALCHIR SUB-DIVISION.										REMARKS.			
	KARNARUINI BEDS.													
	Tachir shales.	1st (bottom) zone.					2nd zone.	3rd zone.		4th zone.				
		11 A shaft, Burigudi.	Chauka.		Poonch-shales.			Poonch-shales.	Lunkh (Kamajpur) Hill.					
			No. 16.	No. 102.	No. 102.	No. 60.								
<i>Glossopteris communis</i> , Fstm. ...	...	...	...	+	+	+	+	+	+	The same species in the Damudas elsewhere. Genus in New South Wales. <i>Gl. ampl.</i> Dan., shows somewhat similar venation.				
<i>Glossopteris</i> (<i>damudica</i> , n. sp.) ...	...	...	...	...	...	...	...	+	...	The same species in the Damudas.				
<i>Glossopteris</i> , sp. ...	+	...	...	...	...	...	...	...	...	...				
<i>Glossopteris decipiens</i> , Fstm. ...	+	...	...	...	...	+	...	...	...	Transitional form.				
<i>Sagenopteris (?) stoliczkanus</i> , Fstm. ...	...	...	...	+	...	...	...	...	...	Genus in Europe mesozoic.				
III.—CYCADACEÆ.														
<i>Glossosaurus stoliczkanus</i> , Fstm. ...	...	...	...	+	...	...	...	...	...	Genus mesozoic in Europe.				
a.— <i>Nöggerathiopsidea</i> .														
<i>Nöggerathiopsis hislopi</i> , Baub. sp. ...	+	...	...	+	+	...	...	+	+	The same genus it seems occurs also in Australia, if the Australian <i>Nöggerathia</i> has to be placed here.				
<i>Nög. hislopi</i> , var. <i>subrhomboidalis</i> ...	...	...	...	...	...	+	...	...	...	...				
IV.—CONIFERÆ. (?)														
<i>Europhyllum whittianum</i> , Fstm. ...	...	+	...	...	...	...	No fossils occurred up to date.	...	...	...				
V.—CONIFERÆ.														
<i>Foltzia heterophylla</i> , Bgt. ...	...	+	...	+	...	...	...	...	...	The same species in European Trias.				
<i>Albertia</i> , sp. ...	...	+	...	...	...	...	...	...	...	Very close to <i>A. b. speciosa</i> from the European Trias.				
<i>Fossil seeds</i> ...	...	+	...	...	+	...	...	...	...	...				
Twenty-six forms ...	8	12	2	1	6	7	4	2	3	...	4	5	4	...

DISTRIBUTION OF FOSSIL PLANTS IN THE MOHPANI COAL-FIELD.

I have mentioned already (p. 4) the relations of the Talchirs and coal-measures as described in the report on the Mohpáni coal-field.¹ I have also mentioned the plant remains which were collected. It remains to make some remarks on the distribution of the plants, and on the analogy of the fossiliferous bands there with those in the Karharbári coal-field.

At present, mines of any importance are opened only at one spot, close to the banks of the Sitariva river. According to the account of the mining officers, four seams of coal are known to occur. They are here numbered, in descending order, not as in the Karharbári coal-field, where the 1st seam is the lowest. All the seams crop out in the bed of the river, but have a high dip. Only one seam, or rather the shale of one seam, has been found fossiliferous at present, *i. e.*, that of the upper seam. The mines are worked by inclines, so there are no such complete sections as those from the several shafts in the Karharbári coal-field. I must be content with giving only the sequence and thickness of the seams—

1st seam	...	{ Upper portion. Shale and Sandstone—fossils procured from here Lower portion.	...	9'
2nd seam	...	...	...	20' to 30'
3rd and 4th seams	...	...	...	9'

The upper seam contains a parting of sandstone and shale, in both of which, but by far more in the shaly portions, the plant impressions are preserved. They consist almost exclusively of fern leaves with netted venation, besides some indistinct equisetaceous stalks. No fossils were found in the shales of the lower seams, the 3rd and 4th of which are only separated by a band of sandy-micaceous shale, about 18 inches thick. The fossils known to me at present are only very few, and all from the parting in the top seam—

Equisetaceous stalks.

Gangamopteris cyclopteroides, Fstm.

Gang. cyclopteroides, var. *attenuata*.

Glossopteris communis, Fstm., about as frequent as *Gangamopteris*.

There was only one other locality where I could observe traces of fossil plants; this was to the north of the mines in a shallow pit, locally called the Ráticnár pit; it was in a very dilapidated state, so that I could only obtain the following information as to the section:—

a	...	Sandy carbonaceous shales	...	...	?	In these some plant fragments were found.
b	{	Coal	—	—	—	3'
	{	Shales	—	—	—	1' 2'
	{	Coal	—	...	—	4'

¹ Rec. Geo. Sur. India, Vol. III, No. 3.

The plant fragments were—

Glossopteris, a specimen which I could not determine specifically.

Nyggerathiopsis? *hislopi*, Bunb. sp., fragment.

This locality is therefore decidedly unsatisfactory, and it hardly can be taken into consideration, as from the present state of the pit it cannot be ascertained which horizon this fossiliferous band represents when compared with the four seams on the Sitariva. If we now compare the fossils from the 1st (uppermost) seam with those of one of the horizons in the Karharbári coal-field, we shall find that they can best be paralleled with the fossils of the 3rd seam (from below) near Passarabhin; and as I have shown that this 3rd seam in Karharbári still has to be considered as belonging to the Karharbári beds, the remark would extend to this seam in the Mohpáni coal-field and, therefore, also to the underlying seams, which may perhaps be considered as representing the lower seams in the Karharbári coal-field.

We would have therefore the following:—

		Karharbári field.	Mohpáni coal-field.
Damoda Division.		4th seam Lumki (Komaljore) Hill and Bhuddua Hill.	
Talchir Division.	Karharbári beds.	3rd seam in Karharbári field, No. 17B and 17C, near Passarabhin: fossiliferous band within and above the seam.	1st seam in the Mohpáni field, in the river Sitariva: fossiliferous band, the shale within the seam.
		2nd seam: unfossiliferous as far as known at present.	2nd, 3rd, and 4th seams in the Sitariva river mines: unfossiliferous as known at present.
		1st seam: fossiliferous band above the seam.	
	Talchir	Shale and sandstone.	Shale and sandstone.

THE SHÁHPUR (BAITŪOL OR BETŪL) COAL-FIELD.

In the beginning of this year, guided by the published Report on this coal-field,¹ I visited the sections near Mardanpur and Kotmi on the Machna river; the outcrop near Temni on the Táwa river; the section near Tekripura on the Suki river; the outcrops near Dolári on the Táwa river, and the outcrops near Sonáda. The palæontological material is scarce, and only from some of these localities were fragmentary plants collected, *viz.*, near Mardanpur, Kotmi, Tekripura, and Dolári.

The plants from Kotmi and Dolári only seem to indicate an analogy of the beds with those at Mohpáni and with the Karharbári beds; the others appear to be higher. The plant remains from these localities were enumerated in the beginning of this paper (p. 5).

¹ H. B. Medlicott: Rec. Geol. Surv. of India, Vol. VIII, pt. 3.

APPENDIX.

WHILE this paper was going through the press, Mr. I. J. Whitty informed me, in a letter dated 29th November 1878, that the previous numbers of the shafts in the field were replaced by new ones. Not wishing to make all the alterations in the text, I think it preferable to affix here the new numbers of the several shafts mentioned by me in course of description. They are—

Old.							New.
No. 5 D ...	...	...	...	...	...	...	No. 9
" 5 G ...	...	...	...	...	...	...	" 12
" 17 B ...	...	...	...	...	...	...	" 23
" 17 C —	...	...	...	...	...	...	" 24
" 1. Mát(hadi	...	...	...	...	...	...	" 39
" 2. Jogitand	...	...	...	...	...	...	" 35
" 11A (Bariadi)	...	...	...	...	...	...	" 2
" 16. (Chunks)	...	...	...	...	...	...	" 4
" 16A " ...	...	...	...	...	...	...	" 5
" 16G " ...	...	...	...	...	...	...	" 6
" 14. (Domahni)	...	...	...	...	...	...	" 30

I wish also to add some remarks on the third seam. I mentioned on page 41 the shafts No. 17B (23) and 17C (24) as working this seam, and some fossils having been found in the roof of, and within, this seam. That this is, in fact, a separate seam, is well shown in a section from S. W. to N. E., through the shafts 5D (No. 9), No. 33 (40), and 17B (No. 23). No. 5D works the two lowest seams (1 and 2); No. 33 (40) works the third seam, and, at 161' below it, reaches the two lowest seams. No. 17B (23) at present works the third seam only, but is to be sunk also to the lower seams, as it is intended to concentrate the drainage of the lower seams to this point. The same relations exist in shaft No. 17C (24), which at present also works the third seam only.

PLATE I.

- Fig. 1. *SCHIZONEURA*, sp. An equisetaceous stem, with rather short joints, broadly ribbed, and (in the articulations) with remains of leaves. These leaves do not show any trace of a surrounding sheath; on the contrary, they seem free leaf portions on both sides of the stalk. They appear to me to represent portions of *Schizoneura* leaves. Page 8.
Locality.—Talehir shales, in the Deoghur area.
- Figs. 4 & 5. *EQUISETACEOUS* stalks, broadly ribbed, both evidently of the same form, but hardly to be determined. Page 8.
Locality.—Passarabha, in the Karharbári coal-field (Karharbári beds).
- Figs. 6 & 7. *SCHIZONEURA* comp. *MERIANI*, Schimp. Specimens with articulated stalks, short joints, broadly and flatly ribbed, and with fragments of leaves in the joints. These again recall the kind of formation of the *Schizoneura*-leaves, and I compare the remains with *Schizoneura meriani*, Schimp. Page 8.
Locality.—Passarabha, in the Karharbári field.
- Figs. 8 & 9. *VERTEBRARIA INDICA*. Two specimens of a small-branched form, as it occurs especially in the Kamthi group. Page 8.
Locality.—Passarabha, Karharbári field, Karharbári beds.
- Figs. 2 & 3 represent *SCHIZONEURA GONDWANENSIS*. These two specimens being from the Lumki hill, from the highest seam (the 4th), which, considering the other fossils, seems to represent the Barákar group, are not to be considered as belonging to the Karharbári beds. Page 9.



J. Schaumburg Lith.

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PLATE II.

NEUROPTERIS (NEUROPTERIDIUM) VALIDA, Fstm. Page 10.

- Fig. 1. represents the lower portion of a middle-sized specimen with the thick, furrowed rhachis, the lowest and the middle leaflets showing the middle vein.
In the lowest part the leaflets are very small and rounded, without the slightest similarity to the higher ones.
- Fig. 2. The middle portion of a middle-sized frond with all the leaflets more similar to each other. The rhachis pretty thick, furrowed; the leaflets decurrent into the rhachis, with the middle vein marked.
- Fig. 1a. shows an enlarged leaflet from figure 1; it shows the manner in which the middle vein passes out from the rhachis, and how it dissolves into the secondary veins, and shows also the condition of these veins.

Locality.—Buriadi, No. 11A mine, Karhabári coal-field, Karhabári beds.



Stem of *Staphylea trifolia*



Flowered branch, *Staphylea trifolia*



Leaf



PLATE III.

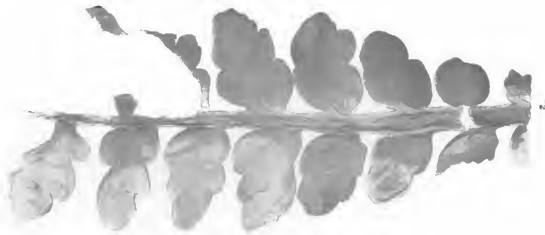
NEUROPTERIS (NEUROPTERIDIUM) VALIDA, Fstm. Page 10.

- Fig. 1. shows an entire frond, but of a small size only; in spite of this, the rachis is pretty thick, furrowed; shows all the three states of the leaflets, the lower ones rounded with entire margin, the middle ones slightly lobed, the upper ones shorter again. The top leaflet is subrhomboidal. The veins are a little exaggeratedly shown, especially the secondary veins appear thicker than they really are.
- Fig. 2. A middle portion of a middle-sized specimen, the leaflets deeply lobed, not showing, however, the veins distinctly; indications of the middle vein only. The rachis thick.
- Fig. 3. The lower portion of a middle-sized frond.

Locality.—Buriadi, No. 11A mine, Karharbári coal-field, Karharbári beds.



1 *Schumacheria* L.



2



3

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PLATE IV.

NEUROPTERIS (NEUROPTERIDIUM) VALIDA, Fstm. Page 10.

Figs. 1 & 2. Top portions of a pretty large frond. The lower leaves deeply lobed, decurrent into the rachis, showing the lower basal angle auriculate.

The upper leaflets are not so much sinuated.

Of the veins, the middle one is the thickest, but the drawings represent the veins, especially the lateral ones, too thick. The top leaflet subrhomboidal, with obtuse angles.

Locality.—Buriadi, No. 11A mine, Karharbári coal-field, Karharbári beds.



Schizoneurites, about 1 inch



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PLATE V.

NEUROPTERIS (NEUROPTERIDIUM) VALIDA, F&M. Page 10.

- Fig. 1. Upper and middle portions of a large frond; the leaflets deeply lobed and decurrent. The middle veins distinctly marked, and dissolving in the secondary veins. The top leaflet partly preserved.
- Fig. 2. Middle and lower portion of a large frond; the rhachis thick, furrowed; the lowest leaflets round, only slightly emarginated; the upper ones deeply lobed, belonging to the middle portion of the frond. This specimen represents about the half, at the most two-thirds of the whole frond, so that the fronds appear to have attained a very large size. This seems to be shown still more by fig. 3.
- Fig. 3. The lower portion of a very large frond; the rhachis is very thick, specially in the lower part; the lowest leaflets round, and showing an indication of the middle vein. The upper leaflets are only slightly lobed, so that, I think, they still belong to the lower portion, in which case this specimen would represent about one-third of the frond.

Locality.—Buriadi, No. 11A mine, Karharlóri field, Karharlóri beds.

Grass, 1880

LOW 1 P

END N V A S

11 V



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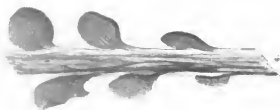
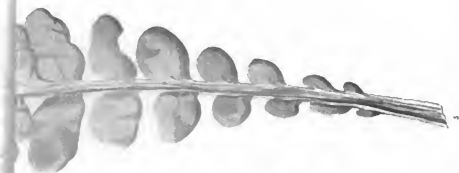
1880



PLATE VI.

NEUROPTERIS (NEUROPTERIDIUM) VALIDA, Fstm. Page 10.

- Fig. 1. Several leaflets of the middle portion indicating a large frond; the leaflets are long and deeply, almost pinnately, lobed, but also decurrent.
- Fig. 2, to which belongs fig. 6, is the lower portion of a big frond; the rhachis is very thick and the upper leaflets deeply lobed, the lower lobe projecting in the form of an auricula.
- These specimens, figs. 1 and 2, are from the large slab of shale presented by Mr. I. J. Whitty, the Superintendent of the Karharbári collieries, in 1876.
- Fig. 3 is the lower portion of a frond, which appears also to have been a very long one, as from the appearance, I would think that it represents the lower third of the frond; the lower leaflets small and round, are a little more apart than in the other specimens; of the veins, the middle one only is slightly indicated.
- Fig. 4 is also a lower portion of a frond, which appears stronger, although not, perhaps, so long as the preceding one. The lower leaflets are larger, although also round and closer, and the upper ones (the middle ones of the frond) lobed. Middle veins marked.
- Fig. 5 shows again an entire frond, preserved on the large slab sent by Mr. I. J. Whitty. It represents a small frond only, although larger than that on Plate III, fig. 1.
- The lowest leaflets, occupying about two-fifths of the frond, are entire, round, decurrent, with the middle vein indicated here and there.
- The middle leaflets, occupying also about two-fifths of the frond, are longer and deeply lobed, with the veins in some of them indicated.
- The upper leaflets, occupying about one-fifth of the frond, differ a little from those in fig. 1, Plate III, being still slightly lobed.
- The terminal leaflet, in outline subrhomboidal, seems also twice lobed.
- Locality.*—All these specimens are from Buriadi, No. 11A mine, Karharbári coal-field, Karharbári beds.



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J. Schaumburg and son Lith.



PLATE VII.

Figs. 1 & 2. GANGANOPTERIS CYCLOPTEROIDES, Fstm. Page 12.

These two figures are of the original specimens of the "*Cyclopteris*-like" leaf from the Talchir shales.

They show the broad-leaved form with the *Cyclopteris*-like disposition of the veins which, however, form a net venation. There is no midrib, its place only being indicated by some thicker veins, especially in the lower portion, from where then the others originate, forked and anastomosing.

These are the two largest specimens of the leaves from the Talchir shales. I consider this species as representative of *Gang. obliqua* from Victoria (Bacchus-Marsh sandstone).

Locality.—Talchir shales, Kumar, Purgunnah Saruth-Deoghur, Beerbhoom (Karaon field).



Scale 1:1,000,000

Printed at Geol. Surv. Office.



PLATE VIII.

The figure on this plate shows the upper half of the leaf in fig. 2, Pl. VII, twice enlarged. It shows well the anastomosing veins, the nets are oblong and narrow.

Locality.—The same as mentioned on Plate VII.



J. Schramberg Lith.

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PLATE IX.

GANGAMOPTERIS CYCLOPTEROIDES, Fstm. Page 12.

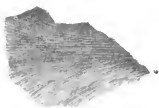
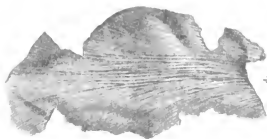
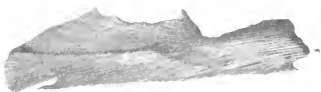
Fig. 1 is the lower half of the leaf in fig. 2, Pl. VII, twice enlarged; it shows the stronger veins of the lower portion, which may, to some extent, be considered representative of a midrib.

Figs. 2, 4, & 6 represent portions of smaller leaves of the same species, with a network in different states.

Fig. 5. This specimen represents what I think to be *Gangamopt. angustifolia*, McCoy, although it is only a portion of the leaf, which seems to represent the larger form of this species. Page 16.

Locality.—All these specimens are from Kumar, Purgunnah Saruth-Deoghur, Beerboom (Karon coal-field).

Small Sars of India



Printed at Geol. Survey Office.

J. Schumann, Lith.



PLATE X.

- Fig. 1. *GANGAMOPTERIS CYCLOPTEROIDES*, F&M., var. *SUBAURICULATA*. This is the longer variety of *G. cyclopteroides*, with the basal angles somewhat auriculate. This leaf from the Talchir shales is, however, not so long by far as those which are figured from the Karharbári beds. Page 13.
- In the lower portion some stronger veins mark, as it were, the midrib.
- Fig. 1a is an enlarged view of the lower portion of the leaf, and fig. 1b an enlarged view of the upper portion.
- Fig. 2. *GANGAMOPTERIS CYCLOPTEROIDES*, var. *AREOLATA*. A portion of the lower part of a leaf, which I think belongs to this variety. The outline is indicated according to the specimen on Plate XVI, fig. 4. Page 14.
- Locality.—Talchir shales, Káranpura coal-field.
- Fig. 3. A small specimen of *G. cyclopteroides* from the Talchir shales of the Karaon field (Kumar, Purgunnab Saruth-Deoghur, Beerbhoom).

LOWER GUOWANAS

Scale given in fathoms.



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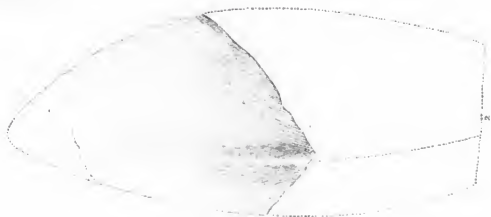
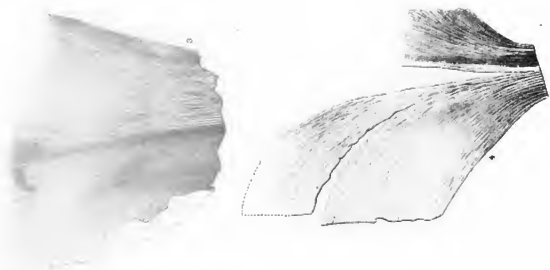
Engraved by J. Thompson



PLATE XI.

- Fig. 1. *GANGAMOPTERIS CYCLOPTEROIDES*, var. *ATTENUATA*. Pretty complete leaf, although shorter than those from the Karharbári coal-field; the nets long and narrow, the basal portion attenuate, with an embracing base. Page 14.
- Figs. 2, 3, & 4. Fragments of *Gang. cyclopteroides*, Fetz., which belong to the original species, although a little smaller. Page 12.

Locality.—Talcbir shales, Káranpura coal-field.



Ideal Curve of Indian

Printed at West Nyack Office

J. Bohannon, D. G. G.



PLATE XII.

- Fig. 1. *GANGAMOPTERIS CYCLOPTEROIDES*, var. *ATTENUATA*. Specimen resembling that on Plate XI, fig. 1, although it would appear, if restored, broader. Page 14.
- Figs. 2 & 3. *GANGAMOPTERIS CYCLOPTEROIDES*, Fstm., of the original Talschir form: fig. 2 appears more as the basal portion, fig. 3, the top portion. Both exhibit the characteristic net venation. Page 12.

Locality.—Buriadi, No. 11A mine, Karhabári coal-field, Karhabári beds.

LOWER GONDWANA

Hand Spec. of India



Traced at Hand Spec. of India

of Gondwana, India



PLATE XIII.

- Figs. 1 & 5. *GANGAMOPTERIS CYCLOPTEROIDES*, Fstm. Two specimens of the original Talchir form. The meshes very narrow and oblong. Pages 12, 13.
Locality.—Máthadi, shaft No. 1, Karharbári coal-field (fig. 1), and Passarabhis, No. 5D, in the same coal-field (fig. 5).
- Fig. 2. *GANGAMOPTERIS CYCLOPTEROIDES*, var. *SUBAURICULATA*. The lower (basal) portion of the leaf with the somewhat auriculate basal angle, the lateral meshes a little larger than in the other specimens. Page 13.
Locality.—Buriadi, No. 11A mine, Karharbári field, Karharbári beds.
- Fig. 3. *GANGAMOPTERIS CYCLOPTEROIDES*, var. *ATTENUATA*. A small specimen. Page 14.
Locality.—Máthadi, No. 1 shaft, Karharbári field, Karharbári beds.
- Fig. 4. *SAGENOPTERIS* (?) *STOLICKIANA*, Fstm.: From the relative position of the leaves, from their *form* and anastomosing venation, this specimen appeared to me to belong to *Sagenopteris*. Page 18.
Locality.—Domahni, Karharbári coal-field, Karharbári beds.
- Fig. 6. Fernrhizome? Belonging perhaps to *N. valida*. Page 18.
Locality.—Buriadi, No. 11A mine, Karharbári coal-field, Karharbári beds.



PLATE XIV.

- Fig. 1 & 2. *GANGAMOPTERIS CYCLOPTEROIDES*, Felm., var. *ATTENUATA*. Two specimens, differing from the original form by their longer leaves, with a strongly attenuate base; the base is apparently embracing, and the basal angles show a tendency to become auriculate.

The venation is radiating, but anastomosing, there being some stronger veins in the lower portion, which run more straightly into the leaf, from which, however, the secondary veins pass out. Page 14.

- Fig. 3. *GANGAMOPTERIS MAJOR*, Felm. In general form reminding of the *Gang. spathulata*, McCoy, from Victoria; it differs by the larger size, by the more attenuate base, and by the veins passing out from the base straightly radiating, and in the upper portion only slightly arcuate. Nets narrow and oblong. Page 15.

Locality.—All from Buriadi, No. 11 A mine, Karhabári coal-field, Karhabári beds.



J. Schaumburg-Lieb

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PLATE XV.

Figs. 1, 2, & 3. *GANGANOPTERIS CYCLOPTEROIDES*, var. *SUBAURICULATA*. Three leaves, with the general disposition of the veins (at least in the upper portion) like in the original species, but which are much longer, with a slightly attenuate base, the angles of which are somewhat auriculate, the base being embracing. From the base some stronger and straight veins run up into the leaf, where they radiate, while the lateral veins in the basal portion pass out divergingly from the base and from the middle straight veins.

This variety represents the longest forms of this species, and I may perhaps, say, of the genus. Page 13.

[By an oversight the figures were numbered from right to left instead from left to right; this is, however, of no consequence, all the three specimens representing one form and being from the same locality].

Locality.—Buriadi, No. 11A mine, Karharbári coal-field, Karharbári beds.



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London: J. G. & Co.



PLATE XVI.

- Figs. 1 & 2. *GANGAMOPTERIS MAJOR*, Fstm., of which fig. 1 agrees with that given on Pl. XIV, 3, although it is longer and much more attenuate in the basal portion.
- Fig. 2, on the contrary, is shorter and with an obtusely rounded apical portion, by which it partly differs from the other forms of this species, but the disposition of the veins, especially their passing out from the base, is the same as in the longer forms, so that I did not see any reason for separating this specimen from the others, in spite of the difference in the apical portion. Page 15.
- Fig. 2a. is an enlarged portion of the lower part of the leaf, fig. 2.
- Fig. 3. *GANGAMOPTERIS CYCLOPTEROIDES*, var. *SUBAURICULATA*. Another large specimen of the same variety as figured on Pl. XV.
- Fig. 4. *GANGAMOPTERIS CYCLOPTEROIDES*, var. *AREOLATA*. This variety agrees in general shape with *Gang. cyclopt.*, var. *subauriculata*; the basal lateral veins, however, form shorter and broader polygonal meshes, the basal angles are not so much auriculate. Page 14.
- Fig. 4a. A portion of the top part of the same, enlarged.
- Fig. 5. A small specimen of a *Gangamopteris cyclopteroidea*, var. *attenuata*. Page 14.
- Locality.—Buriadi, No. 11 A mine, Karharbári coal-field, Karharbári beds.



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J. H. Mendenhall, Lith.



PLATE XVII.

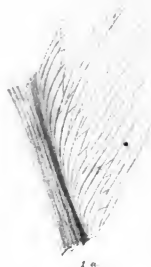
Figs. 1 & 2. *GLOSSOPTERIS COMMUNIS*, Fstm. This form is very common in the Damuda sub-division.
Rarer in the Karharbári beds.

Fig. 1 shows the middle portion of a pretty large leaf; the midrib is quite distinct, the secondary veins pass out at acute angles and form narrow and long meshes; close to the midrib they are a little broader. Page 16.

Fig. 2 is the top portion of the same species.

Fig. 1a shows a portion of the leaf enlarged to illustrate the net venation.

Locality.—Máthadi, No. 1 shaft, Karharbári field, Karharbári beds, bottom seam. (More frequent in the same coal-field, but in the 3rd seam).



1a



2.



1.

✓ Zoroasteria

Trilobites of the Fossiliferous



PLATE XVIII.

Figs. 1 & 2. *GANGAMOPTERIS BURIADICA*, Fstm. Linear, oblong, spatulate leaves, with an obtusely rounded apex; veins straightly radiating into the leaf from some stronger basal veins, forming very long and narrow meshes; the base angustate. It is very possible that this species was pinnate. Page 15.

Fig. 2a. A portion of the leaf enlarged.

Figs. 3, 4, & 5. *GLOSSEOPTERIS DECIPiens*, Fstm. This leaf has a distinct midrib coming up to the upper third, where it dissolves into the secondary veins, which thence are radiating; in the other portion of the leaf the secondary veins pass out from the midrib at pretty acute angles; the nets are tolerably distinct, but narrower and longer in the upper portion. Page 17.

Locality.—All the specimens are from Buriadi, No. 11A mine, Karharbári coal-field, Karharbári beds (bottom seam).



Found at the same place



Found at the same place



PLATE XIX.

- Fig. 1. *NÖGGERATHIOPSIS* (*NÖGGERATHIA*) *HISLOPI*, Bunb. sp. A fragmentary specimen, with the outline restored, the apex, perhaps, rather a little too much obtusely shown. The veins, however, are distinctly enough seen, straight, slightly diverging and furcate. Page 23.
Locality.—Talchir shales, Karan field (Kumar, Purgunnah Saruth-Deoghur, Beerbhoom).
- Figs. 2 & 6. Leaves of the same species, better preserved, fig. 6 showing partly the basal portion and distinctly the furcation of the veins.
- Fig. 6a. An enlarged portion of the lower part of the leaf showing the furcation of the veins. Page 24.
Locality.—Buriadi, No. 11A mine, Karharbári coal-field, Karharbári beds.
- Figs. 3, 4, & 5. Three smaller specimens, which, however, I think, belong also to the same species, the shape of the leaf and the distribution, as also the other characters of the veins, being the same. Page 24.
Locality.—Domahni, Karharbári coal-field, Karharbári beds.



1. Schumacher 1862

2. Hunted as Heil. Survey Office



PLATE XX.

- Fig. 1. *NÖGGERATHIOPSIS HISLOPI*, Bunb. sp. A large leaf showing distinctly the veins, thickish in the basal portion and then divergingly furcate.
- Fig. 1a shows a portion of the same enlarged. Page 23.
Locality.—Buriadi, No. 11A mine, Karharbári field, Karharbári beds.
- Fig. 3 is a fragmentary specimen, which, however, seems to belong to the same form, and it is also from the same locality.
- Fig. 2. *NÖGGERATHIOPSIS HISLOPI*, Bunb. sp., var. *SUBRHOMBODALIS*. A leaf with a more attenuate base, and a broader apical portion, so as to form a subrhomboidal outline. Page 24.
Locality.—Jagitand, No. 2 shaft, Karharbári coal-field, Karharbári beds.
- Figs. 4 & 5. *GLOSSOZAMITES STOLICEKANUS*, Fesm. Two leaves, belonging to each other as positive and negative impressions, with a broad base, basal angles round and subauriculate, and the veins from the base several times furcate divergently. Page 19.
Locality.—Domahni, in the same coal-field.

Pl. XX

LOWER GONDWANA

Geol. Surv. of India



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PLATE XXI.

Fig. 1. *EURYPHYLLUM WHITTIANUM*, Fstm. Page 26.

The figure shows two leaves and a portion of a stem, to which the upper of the two leaves is apparently attached; the other leaf, the lower one, is not in direct connection with the stem, but still in such a position relatively to it that there is but little doubt that it belongs to the same. In the lower portion of the stem, about in the median line, there is seen an oblongly ovate mark, which in all probability indicates the place where a leaf was attached to the stem, and it is quite possible that the lower of the two leaves was attached here, although, on the other hand, it is not improbable that the point of insertion might be in that part of the stem close to which the leaf is lying. From this relation of the leaves to the stem, as indicated, it would appear that they were attached in spirals or in quincunx, which would exclude this specimen from the *Cycadeaceae* and class it rather with the *Coniferae*.

The leaves are broad, attenuate at base, veins coming out strongly from the base, and then many times divergently furcate. The leaves appear thinly coriaceous.

Fig. 1a, shows a portion enlarged.

Locality.—Buriadi, No. 11A mine, Karharbári coal-field, Karharbári beds.



PLATE XXII.

Figs. 1—6. *VOLTZIA HETEROPHYLLA*, Bgt. Page 28.

Figs. 1 & 2 are leaved branchlets with different-looking leaflets; no veins could be observed; fig. 2 shows well the spiral disposition of the leaflets.

Figs. 3, 4 & 5 are portions of stems, preserved on the same specimen of shale; they show markings on their surface, as we find them in coniferous branches and stems, and there is little doubt that they belong to *Voltzia*, the more so as there are the leaflets partly preserved. It appears to me also that these three stem portions (3,4,5), as can be judged from their mutual position, belong to one specimen.

Fig. 6, is another stem fragment, showing markings on the surface and fragments of leaflets.

Locality.—Burindi, No. 11A mine, Karharbári field, Karharbári beds (bottom seam).



1. *Stem of a tree, as preserved*

2. *Stem of a tree, as preserved*



PLATE XXIII.

Figs. 1—5. *VOLTZIA HETEROPHYLLA*, Bgt. Page 28. Several branched and leaved specimens, showing the disposition of the leaflets, partly also the leaf-scars on the surface.
Locality.—Buriadi, No. 11A mine, Karharbári coal-field, Karharbári beds.



J. Schaumburg ad nat. lith.⁴

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PLATE XXIV.

- Figs. 1 & 2. Branched and leaved specimens, which are probably of *Albertia*, partly with leaf-scars on the surface. Page 29.
Locality.—Buriadi, No. 11A mine, Karhabári coal-field, Karhabári beds.
- Fig. 3. *ALBERTIA*, sp. This is a specimen which I think to be distinct from *Foltzia*, on account of the much broader leaflets, so that I would rather place it nearer the specimen on Pl. XXVI, fig. 2.
Locality.—The same.
- Fig. 4. *VOLTZIA HETEROPHYLLA*, Bgt. Leaved branchlet.
Locality.—Domahni, Karhabári coal-field, Karhabári beds.
- Fig. 5. Fossil seed. Page 30.
- Fig. 6. *GLOSSOPTERIS DECIPiens*, Fstm. Page 17. The same form as the specimens on Pl. XVIII, figs. 4, 5.
Locality.—Buriadi, No. 11A mine, Karhabári field, Karhabári beds.



1. *Schumacheria* cf. *indica* (det.)

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PLATE XXV.

Figs. 1—3. *VOLTZIA HETEROPHYLLA*, Bgt. Page 28. Three large specimens, of which fig. 3 is the most characteristic form, bearing the appearance of *V. heterophylla-rigida*, while fig. 1 reminds partly of *V. acutifolia* and *rigida*, and fig. 2 of *V. heterophylla* and *brevifolia*.

I could not observe veins in the leaflets.

Locality.—Buriadi, No. 11A mine, Karharbári field, Karharbári beds, above bottom seam. All three are on the big slab of shale which Mr. I. J. Whitty sent to the Museum.



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J. Schramburg and not lith.



PLATE XXVI.

- Fig. 1. GANGAMOPTERIS CYCLOPTEROIDES, *Fatm.* Page 12. This specimen belongs, I think, to the original form, although it is of greater length. The veins form very narrow oblong meshes.
- Fig. 3 (by mistake, instead of 1a) shows a portion of the leaf enlarged to illustrate the venation.
- Fig. 2. ALBERTIA. Page 29. This specimen agrees in all characters with *Alb. spectiosa*. Schimp., so that at first I identified it with this species; but later, when the specimen, Pl. XXIV, fig. 3, was discovered, which I think also an *Albertia*, and perhaps in relation with the present specimen, I did not think it advisable to maintain the identification, although it is not impossible that both specimens belong to different forms, in which case I would still consider the specimen now under consideration as *Alb. spectiosa*, Schimp.

Locality.—Both specimens figured on this Plate are from Buriadi, No. 11A mine, Karharbári field, Karharbári beds, and preserved on the large slab of shale sent to the Museum by Mr. I. J. Whitty.



J. Schumberg Lith.



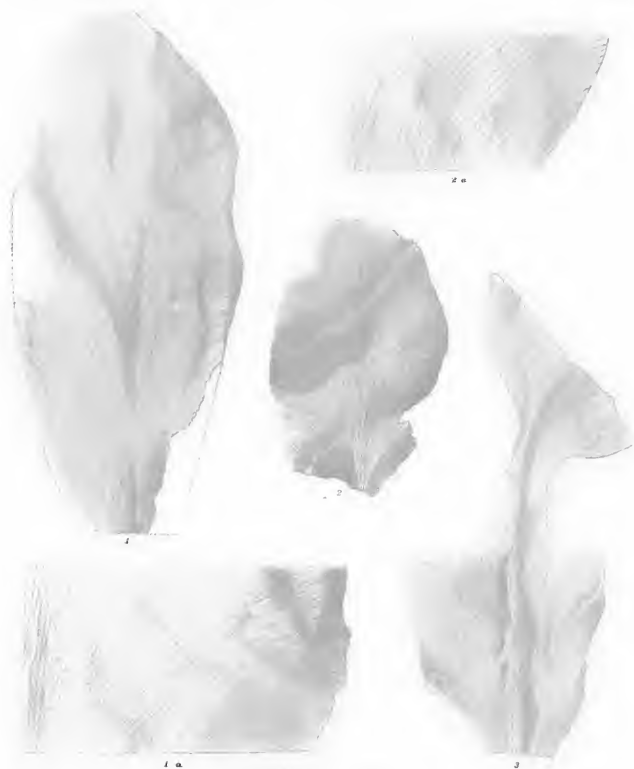
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PLATE XXVII.

Figs. 1, 2, & 3. GANGAMOPTERIS CYCLOPTEROIDES, Fstm. Page 12. Fig. 1 appears to represent the var. *attenuata*, while figs. 2, 3 seem to be of the original form.

Figs. 1a & 2a are enlarged portions of the respective leaves to show the net venation.

Locality.—The figures on this Plate are of specimens from the Mohpáni collieries (Sátpura basin), and I think they establish the analogy between these beds and the Karharbári beds in the Karharbári coal-field.



1. *Schizanthus* (Linn.)

2. *Schizanthus* (Linn.)

621. 62. 6. 1/2.
625. 2.

